



The Department of Defense

Small Business Technology Transfer (STTR)

FY 2000

PROGRAM SOLICITATION

Closing Date: 12 April 2000

DoD Departments/Agencies:



Department
of the Army



Department
of the Navy



Department of
the Air Force



Ballistic
Missile Defense
Organization

20000210 014



Defense Advanced
Research Projects
Agency

PROGRAM SOLICITATION

Number 2000

Small Business Technology Transfer (STTR) Program

IMPORTANT

The DoD updates its SBIR/STTR mailing list annually. To remain on the mailing list or to be added to the list, send in the Mailing List form (Reference I), found at the back of this solicitation or complete the electronic form at <http://www.teltech.com/sbir/form.html>. Failure to send in the form annually will result in removal of your name from the mailing list.

If you have questions about the Defense Department's STTR program, please call the SBIR/STTR Help Desk at (800) 382-4634, or see the DoD SBIR/STTR Home Page, at <http://www.acq.osd.mil/sadbu/sbir>.

DISTRIBUTION STATEMENT A Approved for Public Release Distribution Unlimited

U.S. Department of Defense
STTR Program Office
Washington, DC 20301

January 4, 2000:	Solicitation issued for public release
March 1, 2000:	DoD begins accepting proposals
April 12, 2000:	Deadline for receipt of proposals at the DoD Components by 3:00 p.m. local time



OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON DC 20301-3000



ACQUISITION AND
TECHNOLOGY

IMPORTANT NEW INFORMATION ABOUT THE DOD STTR PROGRAM

1. **The DoD SBIR/STTR Help Desk** can address your questions about this solicitation, the proposal preparation process, contract negotiations, getting paid, government accounting requirements, intellectual property protection, the Fast Track, obtaining outside financing, and other program-related areas. You may contact the Help Desk by:
 - Phone: 800-382-4634 (8AM to 8PM EST)
 - Fax: 800-462-4128
 - Email: SBIRHELP@teltech.com
2. **The DoD SBIR/STTR Web Site** (<http://www.acq.osd.mil/sadbu/sbir>) offers electronic access to many important resources for STTR participants, such as the initial public release of each STTR solicitation, sample STTR proposals, model STTR contracts, links to the Component STTR programs within DoD, answers to commonly-asked questions about STTR contracting, descriptive data on the STTR program, and the latest program updates.
3. **Starting with this solicitation, your STTR Proposal Cover Sheet (formerly, "Appendix A and B") and Company Commercialization Report must be submitted electronically through the Web Site www.dodsbir.net/submission**, as described in Sections 3.4.b and 3.4.n beginning March 1, 2000.
4. **DoD has adopted commercialization of SBIR/STTR technology (in military and/or private sector markets) as a critical measure of performance** for both the DoD STTR program and the companies that participate in the program. This new policy is reflected in Sections 3.4h and 3.6 of this solicitation (Commercialization Strategy); Section 3.4n (Company Commercialization Report on Prior SBIR Awards); Section 4.4 (Assessing Commercial Potential of Proposals); and Section 5.4 (Commercialization Report Updates).
5. **Under DoD's "Fast Track" policy (section 4.5), STTR projects that attract some matching cash from an outside investor for the Phase II effort have a much higher chance of Phase II award -- see www.acq.osd.mil/sadbu/sbir/fstrack.html#results.** Fast Track projects also receive expedited processing and interim funding between Phases I and II.
6. **You may contact the DoD authors of solicitation topics to ask questions about the topics before you submit a proposal.** Procedures for doing so are discussed in Section 1.5(c) of this solicitation. Please note that you may talk by telephone with a topic author to ask such questions only between January 4, when this solicitation was publicly released, and March 1, when DoD begins accepting proposals. At other times, you may submit written questions as described in Section 1.5c.
7. **An STTR proposal that meets the goals of a solicitation topic but does not use the exact approach specified in the topic will still be considered.** For further information on this new DoD policy, see Section 4.1 of this solicitation.
8. **A number of the Army, Navy, and Air Force topics are supported by a DoD acquisition program (e.g., New Attack Submarine, Abrams Tank), as noted in the text of the topic.** These acquisition programs are potentially important end customers for innovative new products resulting from SBIR projects. Information on how to contact these programs is posted on the DoD SBIR/STTR Web Site at www.acq.osd.mil/sadbu/sbir/acqproj/liaisons.htm.



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DOD PROGRAM SOLICITATION FOR SMALL BUSINESS TECHNOLOGY TRANSFER

1.0 PROGRAM DESCRIPTION

1.1 Introduction

The Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), and Ballistic Missile Defense Organization (BMDO), hereafter referred to as DoD Components, invite small business firms and research institutions to jointly submit proposals under this solicitation for the Small Business Technology Transfer (STTR) program. The STTR Program is a pilot program under which awards are made to small business concerns for cooperative research and development, conducted jointly by a small business and a research institution, through a uniform process having three phases. STTR, although modeled substantially on the Small Business Innovation Research (SBIR) Program, is a separate program and is separately financed. Subject to availability of funds, DoD Components will support high quality cooperative research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector.

The STTR Program is designed to provide a strong incentive for small companies and researchers at research institutions, i.e., non-profit research institutions, contractor-operated federally funded research and development centers (FFRDCs), and universities, to work together as a team to move ideas from the research institution to the marketplace, to foster high-tech economic development, and to address the technological needs of our armed forces. (See Reference H)

Partnerships between small businesses and Historically Black Colleges or Universities (HBCUs) or Minority Institutions (MIs) are encouraged, although no special preference will be given to STTR proposals from such offerors.

The Federal STTR Program is mandated by Public Law 102-564. The basic design of the DoD STTR Program is in accordance with the Small Business Administration (SBA) STTR Policy Directive of 1993. The DoD Program presented in this solicitation strives to encourage scientific and technical innovation in areas specifically identified by DoD Components. The guidelines presented in this solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD and the private sector.

1.2 Three Phase Program

This program solicitation is issued pursuant to the Small Business Research and Development Enhancement Act of 1992, PL 102-564. Phase I is to determine the scientific, technical and commercial merit and feasibility of the proposed cooperative effort and the quality of performance of the small business concern with a relatively small investment before consideration of future DoD support in Phase II. Several different proposed solutions to a given topic may be funded. Proposals will be evaluated on a competitive basis giving primary consideration to the scientific and technical merit of the proposal along with its potential for commercialization. Phase I awards are typically \$60,000 to \$100,000 in size over a period not to exceed one year.

Subsequent Phase II awards will be made to firms on the basis of results of their Phase I effort and the scientific, technical merit and commercial potential of their Phase II proposal. Phase II awards are typically \$400,000 to \$500,000 in size over a period generally not to exceed 24 months (subject to negotiation). Phase II is the principal research or research and development effort and is expected to produce a well-defined deliverable product or process.

Under Phase III, the small business is expected to use non-federal capital to pursue private sector applications of the research or development. Also, under Phase III, federal agencies may award non-STTR funded follow-on contracts for products or processes which meet the mission needs of those agencies.

DoD is not obligated to make any awards under either Phase I, II, or III. DoD is not responsible for any monies expended by the proposer before award of any contract.

1.3 Proposer Eligibility and Limitation

Each proposer must qualify as a small business for research or research and development purposes as defined in Section 2.3 and certify to this on the Cover Sheet of the proposal. In addition, a minimum of 40 percent of each STTR project must be carried out by the small business concern and a minimum of 30 percent of the effort performed by the research institution, as defined in Section 2.4. The percent of work is usually measured by both direct and indirect costs; however, proposers should verify how it will be measured with their DoD contracting officer during contract negotiations.

A small business concern must negotiate a written agreement between the small business and the research institution allocating intellectual property rights and rights to carry out follow-on research, development, or commercialization (see Reference C).

At the time of award of a Phase I or Phase II contract, the small business concern must have at least one employee in a management position whose primary employment is with the small business and who is not also employed by the research institution. Primary employment means that more than one half of the employee's time is spent with the small business.

For both Phase I and Phase II, the research or research and development work must be performed by the small business concern and research institution in the United States. "United States" means the fifty states, the Territories and possessions of the United States, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the District of Columbia.

Joint ventures and limited partnerships are permitted for the small business portion, provided that the entity created qualifies as a small business in accordance with the Small Business Act, 15 USC 631, and the definition included in Section 2.3.

1.4 Conflicts of Interest

Awards made to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees in violation of federal law. Such proposers should contact the cognizant Ethics Counselor from the employees' Government agency for further guidance.

1.5 Questions about STTR and Solicitation Topics

a. General Questions/Information. The DoD SBIR/STTR Help Desk is prepared to address general questions about this solicitation, the proposal preparation process, contract negotiation, payment vouchers, Government accounting requirements, intellectual property protection, the Fast Track, financing strategies, and other program-related areas. The Help Desk may be contacted by:

Phone: 800-382-4634 (8AM to 8PM EST)
Fax: 800-462-4128
Email: SBIRHELP@teltech.com

The DoD SBIR/STTR Home Page offers electronic access to SBIR and STTR solicitations, answers to commonly asked questions, sample proposals, model contracts, abstracts of ongoing SBIR and STTR projects, the latest updates on the SBIR and STTR programs, hyperlinks to sources of business assistance and financing, and other useful information.

DOD SBIR/STTR HOME PAGE:
<http://www.acq.osd.mil/sadbu/sbir>

b. General Questions About a DoD Component.

General questions pertaining to a particular DoD Component (Army, Navy, Air Force, etc) should be submitted in accordance with the instructions given at the beginning of that Component's topics, in Section 8.0 of this solicitation.

c. Technical Questions about Solicitation Topics. On January 4, 2000, this solicitation was issued for public release on the DoD SBIR/STTR Home Page (<http://www.acq.osd.mil/sadbu/sbir>), along with the names of the topic authors and their phone numbers. The names of topic authors and their phone numbers will remain posted on the Home Page until March 1, 2000, giving proposers an opportunity to ask technical questions about specific solicitation topics by telephone.

Once DoD begins accepting proposals on March 1, 2000, telephone questions will no longer be accepted, but proposers may submit written questions through the SBIR/STTR Interactive Topic Information System (SITIS), in which the questioner and respondent remain anonymous and all questions and answers are posted electronically for general viewing. Proposers may submit written questions to SITIS via internet (linked from the DoD SBIR/STTR Home Page), e-mail, fax, mail, or telephone as follows:

Defense Technical Information Center
MATRIS Office, DTIC-AM
ATTN: SITIS Coordinator
NAS North Island, Box 357011
San Diego, CA 92135-7011
Phone: (619) 545-7529
Fax: (619) 545-0019
E-mail: sbir@dticam.dtic.mil
WWW: <http://dticam.dtic.mil/sttr/>

The SITIS service for this solicitation opens on or around January 20, 2000 and closes to new questions on March 31, 2000. SITIS will post all questions and answers on the Internet (see Solicitations on the DoD SBIR/STTR Home Page) from January 20, 2000 through April 12, 2000. (Answers will also be emailed or faxed directly to the inquirer if the inquirer provides an e-mail address or fax number.) Answers are generally posted within seven working days of question submission.

All proposers are advised to monitor SITIS during the solicitation period for questions and answers, and other information, relevant to the topic under which they are proposing.

1.6 Requests for Copies of DoD STTR Solicitation

To remain on the DoD Mailing list for the SBIR and STTR solicitations, send in the Mailing List form (Reference I). You may also order additional copies of this solicitation from:

DoD SBIR Support Services
2850 Metro Drive, Suite 600
Minneapolis, MN 55425-1566
(800) 382-4634

The DoD SBIR and STTR solicitations can also be accessed via internet through the Home Page at <http://www.acq.osd.mil/sadbu/sbir>.

1.7 SBIR/STTR Conferences and Outreach

The DoD holds two National SBIR/STTR Conferences a year and participates in many state-organized conferences for small business. For information on these events, see our DoD SBIR/STTR Home Page (<http://www.acq.osd.mil/sadbu/sbir>). We have a special outreach effort to socially and economically disadvantaged firms.

2.0 DEFINITIONS

The following definitions apply for the purposes of this solicitation:

2.1 Research or Research and Development. Systematic study and experimentation directed toward greater knowledge or understanding of the subject studied or toward applying new knowledge to meet a recognized need.

2.2 Cooperative Research and Development. For the purposes of the STTR Program this means research and development conducted jointly by a small business concern and a research institution in which not less than 40 percent of the work is performed by the small business concern, and not less than 30 percent of the work is performed by the research institution. The percent of work is usually measured by both direct and indirect costs; however, proposers should verify how it will be measured with their DoD contracting officer during contract negotiations.

2.3 Small Business Concern. A small business concern is one that, at the time of award of a Phase I or Phase II contract:

a. Is independently owned and operated and organized for profit, is not dominant in the field of operation in which it is proposing, and has its principal place of business located in the United States;

b. Is at least 51% owned, or in the case of a publicly owned business, at least 51% of its voting stock is owned by United States citizens or lawfully admitted permanent resident aliens;

c. Has, including its affiliates, a number of employees not exceeding 500, and meets the other regulatory requirements found in 13 CFR Part 121. Business concerns, other than investment companies licensed, or state development companies qualifying under the Small Business Investment Act of 1958, 15 USC 661, et seq., are affiliates of one another when either directly or indirectly (1) one concern controls or has the power to control the other; or (2) a third party or parties controls or has the power to control both. Control can be exercised through common ownership, common management, and contractual relationships. The term "affiliates" is defined in greater detail in 13 CFR Sec. 121.103. The term "number of employees" is defined in 13 CFR 121.106. Business concerns include, but are not limited to, any individual, partnership, corporation, joint venture, association or cooperative.

2.4 Research Institution. Any organization that is:

a. A university.

b. A nonprofit institution as defined in section 4(5) of the Stevenson-Wydler Technology Innovation Act of 1980.

c. A contractor-operated federally funded research and development center, as identified by the National Science Foundation in accordance with the government-wide

Federal Acquisition Regulation issued in accordance with section 35(c)(1) of the Office of Federal Procurement Policy Act. (See Ref. H for a list of eligible FFRDCs.)

2.5 Socially and Economically Disadvantaged Small Business. A small business that is at the time of award of a Phase I or Phase II contract:

a. At least 51% owned by an Indian tribe or a native Hawaiian organization, or one or more socially and economically disadvantaged individuals, and

b. Whose management and daily business operations are controlled by one or more socially and economically disadvantaged individuals.

A socially and economically disadvantaged individual is defined as a member of any of the following groups: Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Subcontinent-Asian Americans, or other groups designated by SBA to be socially disadvantaged.

2.6 Women-Owned Small Business. A small business concern that is at least 51% owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

2.7 Funding Agreement. Any contract, grant, or cooperative agreement entered into between any federal agency and any small business concern for the performance of experimental, developmental, or research work funded in whole or in part by the federal government. *Only the contract method will be used by DoD components for all STTR awards.*

2.8 Subcontract. A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by a Federal Government contract awardee calling for supplies or services required solely for the performance of the original contract. This includes consultants.

2.9 Commercialization. The process of developing a product or non-R&D service for sale (whether by the originating party or by others) in government and/or private sector markets.

2.10 HBCU/MI. A list of the Historically Black Colleges and Universities (HBCU) and Minority Institutions (MI) is available through DTIC at 800-363-7247.

3.0 PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

3.1 Proposal Requirements

A proposal to any DoD Component under the STTR Program is to provide sufficient information to persuade the DoD Component that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria.

The quality of the scientific, technical or commercial content of the proposal will be the principal basis upon which proposals will be evaluated. The proposed research or research and development must be responsive to the chosen topic. Any small business contemplating a bid for work on any specific topic should determine that (a) the technical approach has a reasonable chance of meeting the topic objective, (b) this approach is innovative, not routine, and (c) the firm and research institution team have the capability to implement the technical approach, i.e. have or can obtain people and equipment suitable to the task.

It should be recognized that while the STTR Program requires a small business and a research institution to undertake a project cooperatively, the Federal contract is with the small business. The small business, and not the research institution, is to provide satisfactory evidence that it will exercise management direction and control of the performance of the STTR funding agreement. Regardless of the proportion of the work or funding of each of the performers under the contract, the small business is to be primary contractor with overall responsibility for its performance.

Those responding to this solicitation should note the proposal preparation tips listed below:

- Read and follow all instructions contained in this solicitation.
- Use the technical information services from DTIC and other information assistance organizations (Section 7.1 - 7.3).
- Mark proprietary information as instructed in Section 5.6.
- Limit your proposal to 25 pages (excluding company commercialization report).
- Have an agreement between the small business and research institution in place prior to proposal submission (see Section 3.4.o and Reference A).
- Use a type size no smaller than 12 pitch or 11 point.
- Register your firm on the DoD Electronic Submission Web Site (<http://www.dodsbir.net/submission>) and, as instructed on the Web Site, prepare a Proposal Cover Sheet and Company Commercialization Report to be included in your proposal.

3.2 Proprietary Information

If information is provided which constitutes a trade secret, proprietary, commercial or financial information, confidential personal information, or data affecting the national security, it will be treated in confidence to the extent permitted by law, provided it is clearly marked in accordance with Section 5.6.

3.3 Limitations on Length of Proposal

This solicitation is designed to reduce the investment of time and cost to small firms in preparing a formal proposal. Those who wish to respond must submit a direct, concise, and informative research or research and development proposal of no more than 25 pages, excluding Company Commercialization Report, (no type smaller than 11 point or 12 pitch on standard 8½" X 11" paper with one (1) inch margins, 6 lines per inch), *including Proposal Cover Sheet, Project Summary, and any enclosures or attachments*. Promotional and non-project related discussion is discouraged. Cover all items listed below in Section 3.4 in the order given. The space allocated to each will depend on the problem chosen and the principal investigator's approach. In the interest of equity, proposals in excess of the 25-page limitation (including attachments, appendices, or references, but excluding Company Commercialization Report) will not be considered for review or award.

3.4 Phase I Proposal Format

a. **Page numbering.** Number all pages of your proposal consecutively.

b. **Proposal Cover Sheet** Register your firm on the password-protected DoD Electronic Submission Web Site (<http://www.dodsbir.net/submission>). As instructed on the Web Site, prepare a Proposal Cover Sheet, including a brief technical abstract of the proposed R&D project and a discussion of anticipated benefits and potential commercial applications. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released on the Internet; therefore, do not include proprietary or classified information in these sections. Print out a hard copy of the Proposal Cover Sheet from the Web Site and include it, with the appropriate signatures, as the first two pages of your proposal. Also include a photocopy of the signed Proposal Cover Sheet in the additional copies of the proposal that you submit per Section 6.0 of this solicitation. If your firm does not yet have access to the Internet, contact the DoD SBIR/STTR Help Desk (800/382-4634) for assistance.

Through the signature of the Corporate Official of the small business concern and the signature of the appropriate

official of the research institution on the Proposal Cover Sheet, the small business concern AND the research institution certify jointly that:

- (1) The proposing firm meets the definition of small business concern found in section 2.3, the proposing institution meets the definition of research institution found in section 2.4, and the proposed STTR project meets the definition of cooperative research and development as defined in section 2.2, and
- (2) Regardless of the proportion of the proposed project to be performed by each party, the small business concern will be the primary party that will exercise management direction and control of the performance of the STTR award.
- (3) At the time of award, the small business concern will have at least one employee in a management position whose primary employment is with the small business and who is not also employed by the research institution.

If the research institution is a contractor-operated Federally funded research and development center, the appropriate official signing for the contractor-operated Federally funded research and development center certifies additionally that it:

- (4) Is free from organizational conflicts of interests relative to the STTR program;
- (5) Did not use privileged information gained through work performed for an STTR agency or private access to STTR agency personnel in the development of this STTR proposal; and
- (6) Used outside peer review as appropriate, to evaluate the proposed project and its performance therein.

c. Identification and Significance of the Problem or Opportunity. Define the specific technical problem or opportunity addressed and its importance. (Begin on Page 3 of your proposal.)

d. Phase I Technical Objectives. Enumerate the specific objectives of the Phase I work, including the questions it will try to answer to determine the feasibility of the proposed approach.

e. Phase I Work Plan. Provide an explicit, detailed description of the Phase I approach. The plan should indicate what is planned, how and where the work will be carried out, a schedule of major events, and the final product to be delivered. Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

f. Related Work. Describe significant activities directly related to the proposed effort, including any

conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic.

Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short description, (2) client for which work was performed (including individual to be contacted and phone number), and (3) date of completion.

g. Relationship with Future Research or Research and Development.

- (1) State the anticipated results of the proposed approach if the project is successful.
- (2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

h. Commercialization Strategy. Describe, in approximately one page, your company's strategy for converting your proposed STTR research into a product or non-R&D service with widespread commercial use in private sector and/or military markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve and when (i.e., amount of additional investment, sales revenue, etc. – see items a through g in Section 5.4).

i. Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise resume of the principal investigator, including a list of relevant publications (if any), must be included.

j. Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in Reference A) shall be justified under this section. Also state whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name) and local governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

k. Subcontractors/Consultants. All subcontractors, including the research institution partner, must be identified and described according to the guidelines in Reference A. The STTR program may only make awards to small businesses; therefore, the research institution must have a subcontracting arrangement with the small business. More than one subcontractor is allowed;

however, the small business must perform at least 40% of the effort and the research institution listed on Proposal Cover Sheet must perform at least 30% of the work. Subcontractor costs must be detailed at the same level as prime contractor costs in accordance with Reference A (in regards to labor, travel, equipment, etc.). If consultants are involved, such involvement should be described in detail and identified in Reference A.

1. Prior, Current, or Pending Support of Similar Proposals or Awards. *Warning* -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous federal program solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning this, it must be disclosed to the soliciting agency or agencies before award.

If a proposal submitted in response to this solicitation is substantially the same as another proposal that has been funded, is now being funded, or is pending with another federal agency or DoD Component or the same DoD Component, the proposer must so indicate on the Proposal Cover Sheet and provide the following information:

- (1) Name and address of the federal agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
- (2) Date of proposal submission or date of award.
- (3) Title of proposal.
- (4) Name and title of principal investigator for each proposal submitted or award received.
- (5) Title, number, and date of solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
- (6) If award was received, state contract number.
- (7) Specify the applicable topics for each STTR proposal submitted or award received.

Note: If Section 3.4.1 does not apply, state in the proposal "No prior, current, or pending support for proposed work."

m. Cost Proposal. Complete the cost proposal in the form of Reference A for the Phase I effort only. Some items of Reference A may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow the DoD Component to understand how the proposer plans to use the requested funds if the contract is awarded.

- (1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
- (2) Special tooling and test equipment and material cost may be included under Phases I and II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test

equipment must, in the opinion of the Contracting Officer, be advantageous to the government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the government or acquired with government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

- (3) Cost for travel funds must be justified and related to the needs of the project.
- (4) Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

When a proposer is selected for award, the proposer should be prepared to submit further documentation to its DoD contracting officer to substantiate costs (e.g., a brief explanation of cost estimates for equipment, materials, and consultants or subcontractors).

n. Company Commercialization Report on Prior STTR and SBIR awards. If your firm is submitting a Phase I or Phase II proposal, it is required to prepare a Company Commercialization Report through the password-protected DoD Electronic Submission Web Site (<http://www.dodsbir.net/submission>) As instructed on the Web Site, list in the Report the quantitative commercialization results of your firm's prior Phase II projects, including the items listed in section 5.4a through g of this solicitation (sales revenue, additional investment, etc.). The Web Site will then compare these results to the historical averages for the DoD SBIR/STTR Program. Once your firm has completed the Report on the Web Site, print out a hard copy of the Report, sign and date it, and attach it to the back of your proposal.

Your firm may also, at its option, attach to the back of the Report additional, explanatory material (no more than five pages) relating to the firm's record of commercializing its prior SBIR or STTR projects, such as: commercialization successes (in government and/or private sector markets) that are not fully captured in the quantitative results (e.g. commercialization resulting from your firm's prior Phase I projects); any mitigating factors that could account for low commercialization; and recent changes in the firm's organization or personnel designed to increase the firm's commercialization success. The Company Commercialization Report and additional explanatory material (if any) will not be counted toward the 25-page limit for Phase I proposals.

A Report showing that a firm has received no prior Phase II awards will not affect the firm's ability to obtain an STTR award. Firms that do not yet have access to the Internet should contact the DoD SBIR/STTR Help Desk (800/382-4634) for assistance.

o. Agreement between the Small Business and Research Institution. The small business must negotiate a written agreement with the research institution allocating intellectual property rights and rights, if any, to carry out follow-on research, development, or commercialization. The agreement must be finalized and signed by both parties no later than 15 days after the small business receives notification that it has been selected for a Phase I STTR award. The small business must submit this agreement to the awarding agency on request and certify in all proposals that the agreement is satisfactory to the small business. The agreement should, as a minimum, state:

- (1) Specifically the degree of responsibility and ownership of any product, process, or other invention or innovation resulting from the cooperative research. The degree of responsibility shall include responsibility for expenses and liability, and the degree of ownership shall also include the specific rights to revenues and profits.
- (2) Which party may obtain U.S. or foreign patents or otherwise protect any inventions resulting from the cooperative research.
- (3) Which party has the right to any continuation of research including non-STTR follow-on awards.

See Reference C for a guideline or model for such an agreement.

The Federal government will not normally be party to any agreement between the small business concern and the research institution. Nothing in the agreement is to conflict with any provisions setting forth the respective rights of the United States and the small business with respect to intellectual property rights and with respect to any right to carry out follow-on research. All agreements between the small business and the research institution cooperating in the STTR projects, or any business plans reflecting agreements and responsibilities between the parties during the performance of Phase I or II, or for the commercialization of the resulting technology, shall reflect the controlling position of the small business.

3.5 Bindings

Do not use special bindings or cover. Staple the pages in the upper left hand corner of each proposal.

3.6 Phase II Proposal

This solicitation is for Phase I only. A Phase II proposal can be submitted only by a Phase I awardee and only in response to a request from the agency; that is, Phase II is not initiated by a solicitation.

Each proposal must contain a Proposal Cover Sheet and a Company Commercialization Report (see section 3.4 b and n). In addition, each Phase II proposal must contain a two-page commercialization strategy, addressing the following questions:

- (1) What is the first product that this technology will go into?
- (2) Who will be your customers, and what is your estimate of the market size?
- (3) How much money will you need to bring the technology to market, and how will you raise the money?
- (4) Does your company contain marketing expertise and, if not, how do you intend to bring that expertise into the company?
- (5) Who are your competitors, and what is your price and/or quality advantage over your competitors?

The commercialization strategy must also include a schedule showing the quantitative commercialization results from the Phase II project that your company expects to report in its Company Commercialization Report Updates one year after the start of Phase II, at the completion of Phase II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc. – see items a through g in section 5.4).

Additional instructions regarding Phase II proposal preparation and submission will be provided or made available by the DoD Components to all Phase I winners at time of Phase I contract award.

3.7 False Statements

Knowingly and willfully making any false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to \$10,000, up to five years in prison, or both.

4.0 METHOD OF SELECTION AND EVALUATION CRITERIA

4.1 Introduction

Phase I proposals will be evaluated on a competitive basis and will be considered to be binding for six (6) months from the date of closing of this solicitation unless offeror states otherwise. If selection has not been made prior to the proposal's expiration date, offerors will be requested as to whether or not they want to extend their proposal for an additional period of time. Proposals meeting stated solicitation requirements will be evaluated by scientists or engineers knowledgeable in the topic area. Proposals will be evaluated first on their relevance to the chosen topic. A proposal that meets the goals of a solicitation topic but does not use the exact approach specified in the topic will be considered relevant. (Prospective proposers should contact the topic author as described in Section 1.5 to determine whether submission of such a proposal would be useful.)

Proposals found to be relevant will then be evaluated using the criteria listed in Section 4.2. Final decisions will be made by the DoD Component based upon these criteria and consideration of other factors including possible duplication of other work, and program balance. A DoD Component may elect to fund several or none of the proposed approaches to the same topic. In the evaluation and handling of proposals, every effort will be made to protect the confidentiality of the proposal and any evaluations. There is no commitment by the DoD Components to make any awards on any topic, to make a specific number of awards or to be responsible for any monies expended by the proposer before award of a contract.

For proposals that have been selected for contract award, a Government Contracting Officer will draw up an appropriate contract to be signed by both parties before work begins. Any negotiations that may be necessary will be conducted between the offeror and the Government Contracting Officer. It should be noted that only a duly appointed contracting officer has the authority to enter into a contract on behalf of the U.S. Government.

Phase II proposals will be subject to a technical review process similar to Phase I. Final decisions will be made by DoD Components based upon the scientific and technical evaluations and other factors, including a commitment for Phase III follow-on funding, the possible duplication with other research or research and development, program balance, budget limitations, and the potential of a successful Phase II effort leading to a product of continuing interest to DoD. DoD is not obligated to make any awards under Phase II or the Fast Track, and all awards are subject to the availability of funds. DoD is not responsible for any monies expended by the proposer before award of a contract.

Upon written request and after final award decisions have been announced, a debriefing will be provided to unsuccessful offerors on their proposals.

4.2 Evaluation Criteria - Phase I

The DoD Components plan to select for award those proposals offering the best value to the government and the nation considering the following factors.

- a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
- b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
- c. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including government publications, etc., should be contained or referenced in the proposal.

4.3 Evaluation Criteria - Phase II

The Phase II proposal will be reviewed for overall merit based upon the criteria below.

- a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution
- b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
- c. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

The reasonableness of the proposed costs of the effort to be performed will be examined to determine those proposals that offer the best value to the government. Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

Phase II proposal evaluation may include on-site evaluations of the Phase I effort by Government personnel.

Fast Track Phase II proposals. Under the regular Phase II evaluation process, the above three criteria are each given roughly equal weight (with some variation across the DoD Components). For projects that qualify

for the Fast Track (as discussed in Section 4.5), DoD will evaluate the Phase II proposals under a separate, expedited process in accordance with the above criteria, and will select these proposals for Phase II award provided:

- (1) they meet or exceed a threshold of "technically sufficient" for criteria (a) and (b); and
- (2) the project has substantially met its Phase I technical goals

(and assuming budgetary and other programmatic factors are met, as discussed in Section 4.1). Fast Track proposals, having attracted matching cash from an outside investor, presumptively meet criterion (c). Consistent with DoD policy, this process should result in a significantly higher percentage of Fast Track projects obtaining Phase II award than non-Fast Track projects.

4.4 Assessing Commercial Potential of Proposals

A Phase I or Phase II proposal's commercial potential will be assessed using the following criteria:

- a. The proposer's commercialization strategy (see Sections 3.4h and 3.6) and, as discussed in that strategy: (1) any commitments of additional investment in the technology during Phase II from the private sector, DoD prime contractors, non-SBIR/STTR DoD programs, or other sources, and (2) any Phase III follow-on funding commitments; and
- b. The proposer's record of commercializing its prior SBIR and STTR projects, as shown in its Company Commercialization Report (see Section 3.4n). If the "Commercialization Achievement Index" shown on the first page of the Report is at the 5th percentile or below, the proposer will receive no more than half of the evaluation points available under evaluation criterion c in Sections 4.2 and 4.3 ("potential for commercialization"), unless the SBIR program manager for the DoD Component receiving the proposal (Army, Navy, Air Force, etc.) recommends, in writing, that an exception be made for that proposer, and the contracting officer approves the exception.

A Company Commercialization Report showing that the proposing firm has no prior Phase II awards will not affect the firm's ability to win an award. Such a firm's proposal will be evaluated for commercial potential based on its commercialization strategy in item a, above.

4.5 STTR Fast Track

a. **In General.** The DoD STTR program has implemented a streamlined Fast Track process for STTR projects that attract matching cash from an outside investor for the Phase II STTR effort (as well as for the interim effort between Phases I and II). The purpose is to focus STTR funding on those projects that are most likely to be developed into viable new products that DoD and

others will buy and that will thereby make a major contribution to U.S. military and/or economic capabilities.

Outside investors, as defined in DoD's Fast Track Guidance (Reference G), may include such entities as another company, a venture capital firm, an individual investor, or a non-SBIR, non-STTR government program; they do not include the owners of the small business, their family members, and/or affiliates of the small business.

As discussed in detail below, projects that obtain matching funds from outside investors and thereby qualify for the STTR Fast Track will (subject to the qualifications described herein):

- (1) Receive interim funding of \$30,000 to \$50,000 between Phases I and II;
- (2) Be evaluated for Phase II award under a separate, expedited process; and
- (3) Be selected for Phase II award provided they meet or exceed a threshold of "technically sufficient" and have substantially met their Phase I technical goals (and assuming other programmatic factors are met), as described in Section 4.3.

Consistent with DoD policy, this process should prevent any significant gaps in funding between Phases I and II for Fast Track projects, and result in a significantly higher percentage of Fast Track projects obtaining Phase II award than non-Fast Track projects.

All DoD Components administer the Fast Track according to the procedures in this section, except for BMDO. BMDO administers slightly different procedures that have been approved by the Under Secretary of Defense for Acquisition and Technology – see the BMDO proposal instructions in Section 8 of this solicitation.

b. **How To Qualify for the STTR Fast Track.** To qualify for the STTR Fast Track, a company must submit a Fast Track application at least 60 days prior to completion of its Phase I project, unless a different deadline for Fast Track applications is specified by the DoD component funding the project (see the Component's introductory page in Section 8 of this solicitation). The company is encouraged to discuss the application with its Phase I technical monitor; however, it need not wait for an invitation from the technical monitor to submit either a Fast Track application or a Fast Track Phase II proposal.

A Fast Track application consists of the following items:

- (1) A completed Fast Track application form, found at Reference B. On the application form, the company and its outside investor must:
 - (a) State that the outside investor will match both interim and Phase II STTR funding, in cash, contingent on the company's selection for Phase II award, as described on the form at Reference B. The matching rates needed to qualify for the

Fast Track are as follows:

- For companies that have never received a Phase II SBIR or STTR award from DoD or any other federal agency, the minimum matching rate is 25 cents for every STTR dollar. (For Example, if such a company receives interim and Phase II STTR funding that totals \$500,000, it must obtain matching funds from the investor of \$125,000.)
 - For all other companies, the minimum matching rate is 1 dollar for every STTR dollar. (For example, if such a company receives interim and Phase II STTR funding that totals \$500,000, it must obtain matching funds from the investor of \$500,000.)
- (b) Certify that the outside funding proposed in the application qualifies as a "Fast Track investment," and the investor qualifies as an "outside investor," as defined in DoD Fast Track Guidance (Reference G).
- (2) A letter from the outside investor to the company, containing:
- (a) A commitment to match both interim and Phase II STTR funding, in cash, contingent on the company's selection for Phase II award, as discussed on the form at Reference B.
- (b) A brief statement (less than one page) describing that portion of the effort that the investor will fund. The investor's funds may pay for additional research and development on the company's STTR project or, alternatively, they may pay for other activities not included in the Phase II contract's statement of work, provided these activities further the development and/or commercialization of the technology (e.g., marketing).
- (c) A brief statement (less than one page) describing (i) the investor's experience in evaluating companies' ability to successfully commercialize technology; and (ii) the investor's assessment of the market for this particular STTR technology, and of the ability of the company to bring this technology to market.
- (3) A concise statement of work for the interim STTR effort (less than four pages) and detailed cost proposal (less than one page). Note: if the company has already negotiated an interim effort (e.g., an "option") of \$30,000 to \$50,000 with DoD as part of its Phase I contract, it need only cite that section of its contract, and need not submit an additional statement of work and cost proposal.
- The company should send its Fast Track application to

its Phase I technical monitor, with copies to the appropriate Component program manager and to the DoD STTR program manager, as indicated on the back of the application form.

Also, in order to qualify for the Fast Track, the company:

- (1) Must submit its Phase II proposal no later than 30 days prior to completion of its Phase I contract, unless a different deadline for Fast Track Phase II proposals is specified by the DoD Component funding the contract (see the Component's introductory page in Section 8 of this solicitation).
- (2) Must submit its Phase I final report by the deadline specified in its Phase I contract, but not later than 30 days after the effective start date of the contract.
- (3) Must certify, within 45 days after being notified that it has been selected for Phase II award, that the entire amount of the matching funds from the outside investor has been transferred to the company. Certification consists of a letter, signed by both the company and its outside investor, stating that "\$_____ in cash has been transferred to our company from our outside investor in accord with the STTR Fast Track procedures." The letter must be sent to the DoD contracting office along with a copy of the company's bank statement showing the funds have been deposited. IMPORTANT: If the DoD contracting office does not receive, within the 45 days, this certification showing the transfer of funds, the company will be ineligible to compete for a Phase II award not only under the Fast Track but also under the regular Phase II competition, unless a specific written exception is granted by the Component's STTR program manager. Before signing the certification letter, the company and investor should read the cautionary note at Section 3.7. If the outside investor is a non-SBIR/non-STTR DoD program, it must provide a line of accounting within the 45 days that can be accessed immediately.

Failure to meet these conditions in their entirety and within the time frames indicated will generally disqualify a company from participation in the STTR Fast Track. Deviations from these conditions must be approved in writing by the contracting office.

c. Benefits of Qualifying for the Fast Track. If a project qualifies for the Fast Track:

- (1) It will receive interim STTR funding of \$30,000 to \$50,000, commencing approximately at the end of Phase I. Note: Consistent with DoD policy, the vast majority of projects that qualify for the Fast Track should receive interim STTR funding. However, the DoD contracting office has the discretion and authority, in any

particular instance, to deny interim funding when doing so is in the Government's interest (e.g., when the project no longer meets a military need or the statement of work does not meet the threshold of "technically sufficient" as described in Section 4.3).

- (2) DoD will evaluate the Fast Track Phase II proposal under a separate, expedited process, and will select the proposal for Phase II award provided it meets or exceeds a threshold of "technically sufficient" for evaluation criteria (a) and (b), as described in Section 4.3 (assuming budgetary and other programmatic factors are met, as discussed in Section 4.1). Consistent with DoD policy, this process should result in a significantly higher percentage of Fast Track projects obtaining Phase II award than non-Fast Track projects. However, DoD is not obligated, in any particular instance, to award a Phase II contract to a Fast Track project, and DoD is not responsible for any funds expended by the proposer before award of a contract.

- (3) It will receive notification, no later than ten weeks after the completion of its Phase I project, of whether it has been selected for Phase II award.

- (4) If selected, it will receive its Phase II award within an average of five months from the completion of its Phase I project.

d. Additional Reporting Requirement. In the company's final Phase II progress report, it must include a brief accounting (in the company's own format) of how the investor's funds were expended to support the project.

5.0 CONTRACTUAL CONSIDERATIONS

Note: Eligibility and Limitation Requirements (Section 1.3) Will Be Enforced

5.1 Awards (Phase I)

a. Number of Phase I Awards. The number of Phase I awards will be consistent with the agency's RDT&E budget, the number of anticipated awards for interim Phase I modifications, and the number of anticipated Phase II contracts. No Phase I contracts will be awarded until all qualified proposals (received in accordance with Section 6.2) on a specific topic have been evaluated. All proposers will be notified of selection/non-selection status for a Phase I award no later than October 12, 2000. The name of those firms selected for awards will be announced. *The DoD Components anticipate making 50 Phase I awards from this solicitation.*

b. Type of Funding Agreement. All winning proposals will be funded under negotiated contracts and may include a fee or profit. The firm fixed price or cost plus fixed fee type contract will be used for all Phase I projects (see Section 5.5). *Note: The firm fixed price contract is the preferred type for Phase I.*

c. Average Dollar Value of Awards. DoD Components will make Phase I awards to small businesses typically on a one-half person-year effort over a period generally not to exceed one year (subject to negotiation). PL 102-564 allows agencies to award Phase I contracts up to \$100,000 without justification. The typical size of award varies across the DoD Components; it is therefore important for a proposer to read the introductory page of the Component to which it is applying (in Section 8.0) for any specific instructions regarding award size.

5.2 Awards (Phase II)

a. Number of Phase II Awards. The number of Phase II awards will depend upon the results of the Phase I efforts and the availability of funds. *The DoD Components anticipate that approximately 40 percent of its Phase I awards will result in Phase II projects.*

b. Type of Funding Agreement. Each Phase II proposal selected for award will be funded under a negotiated contract and may include a fee or profit. The firm fixed price or cost plus fixed fee type contract will be used for all Phase II projects. *Note: The firm fixed price, level-of-effort contract is the preferred type for Phase II (see sample on our DoD SBIR/STTR Web Site at <http://www.acq.osd.mil/sadbu/sbir/contract.html>), except in the Air Force, where cost plus fixed fee is the preferred type.*

c. Average Dollar Value of Awards. Phase II awards will be made to small businesses based on results of the Phase I efforts and the scientific, technical, and

commercial merit of the Phase II proposal. Average Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). PL 102-564 states that the Phase II awards may be up to \$500,000 each without justification. See special instructions for each DoD Component in Section 8.

5.3 Phase I Report

a. Content. A final report is required for each Phase I project. The report must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page", will be used as the first page of the report. (A blank SF 298 is provided in Reference F of this solicitation.) In addition, monthly status and progress reports may be required by the DoD agency.

b. Preparation.

- (1) If desirable, language used by the company in its Phase II proposal to report Phase I progress may also be used in the final report.
- (2) For each unclassified report, the company submitting the report should fill in block 12a (Distribution/Availability Statement) of the SF298, "Report Documentation Page" with one of the following statements:
 - (a) Approved for public release; distribution unlimited.
 - (b) Distribution authorized to U.S. Government Agencies only; contains proprietary information.

Note: The sponsoring DoD activity, after reviewing the company's entry in block 12a, has final responsibility for assigning a distribution statement.
- (3) Block 13 (Abstract) of the SF 298, "Report Documentation Page" must include as the first sentence, "Report developed under STTR contract for topic [insert solicitation topic number]". The abstract must identify the purpose of the work and briefly describe the work carried out, the findings or results and the potential applications of the effort. Since the abstract will be published by the DoD, it must not contain any proprietary or classified data.
- (4) Block 14 (Subject Terms) of the SF 298 must include the term "STTR Report".

c. Submission. The company shall submit FIVE COPIES of the final report on each Phase I project to the DoD in accordance with the negotiated delivery schedule. Delivery will normally be within thirty days after completion of the Phase I technical effort. The company shall, at the same time, submit ONE ADDITIONAL

COPY of each report directly to DTIC(unless instructed otherwise by the sponsoring DoD activity in the Phase I contract):

ATTN: DTIC-OCA
Defense Technical Information Center
8725 John J Kingman Road, Suite 0944
Ft. Belvoir, VA 22060-6218.

If the report is classified, the sponsoring DoD activity will provide special submission instructions.

Note: The sponsoring DoD activity has final responsibility for ensuring that the company or the DoD activity provide DTIC with all applicable Phase I and Phase II technical reports, classified and unclassified, developed under STTR contract, per DoD Directive 3200.1

(<http://web7.whs.osd.mil/dodiss/directives/dir2.html>)

5.4 Company Commercialization Report Updates

If, after completion of Phase I, the contractor is awarded a Phase II contract, the contractor shall be required to electronically update its Company Commercialization Report (discussed in Section 3.4n) on a periodic basis, to report the following commercialization results of this Phase II project:

- a. Sales revenue from new products and non-R&D services resulting from the Phase II technology;
- b. Additional investment from sources other than the federal SBIR/STTR program in activities that further the development and/or commercialization of the Phase II technology;
- c. The portion of additional investment representing clear and verifiable investment in the future commercialization of the technology (i.e., "hard investment");
- d. Whether the Phase II technology has been used in a fielded DoD system or acquisition program and, if so, which system or program;
- e. The number of patents resulting from the contractor's participation in the SBIR/STTR program;
- f. Growth in number of firm employees; and
- g. Whether the firm has completed an initial public offering of stock (IPO) resulting, in part, from the Phase II project.

These updates on the project will be required one year after the start of Phase II, at the completion of Phase II, and subsequently when the contractor submits a new SBIR or STTR proposal to DoD. Firms that do not submit a new proposal to DoD will be asked to provide updates on an annual basis after the completion of Phase II.

5.5 Payment Schedule

The specific payment schedule (including payment amounts) for each contract will be incorporated into the contract upon completion of negotiations between the DoD and the successful Phase I or Phase II offeror. Successful offerors may be paid periodically as work progresses in

accordance with the negotiated price and payment schedule. Phase I contracts are primarily fixed price contracts, under which monthly payments may be made. The contract may include a separate provision for payment of a fee or profit. Final payment will follow completion of contract performance and acceptance of all work required under the contract. Other types of financial assistance may be available under the contract.

5.6 Markings of Proprietary or Classified Proposal Information

The proposal submitted in response to this solicitation may contain technical and other data which the proposer does not want disclosed to the public or used by the government for any purpose other than proposal evaluation.

Information contained in unsuccessful proposals will remain the property of the proposer except for the Proposal Cover Sheet. The government may, however, retain copies of all proposals. Public release of information in any proposal submitted will be subject to existing statutory and regulatory requirements.

If proprietary information is provided by a proposer in a proposal which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security, it will be treated in confidence, to the extent permitted by law, provided this information is clearly marked by the proposer with the term "confidential proprietary information" and provided that the following legend which appears on the Proposal Cover Sheet (Section 3.4b) is completed:

"For any purpose other than to evaluate the proposal, this data referenced below, shall not be disclosed outside the government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a contract is awarded to the proposer as a result of or in connection with the submission of this data, the government shall have the right to duplicate, use or disclose the data to the extent provided in the funding agreement. This restriction does not limit the government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained on the pages of the proposal listed on the line below"

Any other legend may be unacceptable to the government and may constitute grounds for removing the proposal from further consideration and without assuming any liability for inadvertent disclosure. The government will limit dissemination of properly marked information to within official channels.

In addition, each page of the proposal containing proprietary data which the proposer wishes to restrict must be marked with the following legend:

"Use or disclosure of the proposal data on lines

specifically identified by asterisk (*) are subject to the restriction on the Cover Sheet of this proposal."

If all the information on a particular page is proprietary, the proposer should so note by including the word "PROPRIETARY" in both the header and footer on that page.

The government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the Freedom of Information Act, 5 USC 552, the proposer will be advised of such request and prior to such release of information will be requested to expeditiously submit to the DoD Component a detailed listing of all information in the proposal which the proposer believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the proposer will ensure that any information released by the DoD Component pursuant to the Act is properly determined.

Those proposers that have a classified facility clearance may submit classified material with their proposal. Any classified material shall be marked and handled in accordance with applicable regulations. Arbitrary and unwarranted use of this restriction is discouraged. Offerors must follow the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M) procedures for marking and handling classified material.

5.7 Copyrights

To the extent permitted by statute, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

5.8 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with government support. The government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the government will not make public any information disclosing a government-supported invention for a period of five years to allow the awardee to pursue a patent.

5.9 Technical Data Rights

Rights in technical data, including software, developed under the terms of any contract resulting from proposals

submitted in response to this solicitation generally remain with the contractor, except that the government obtains a royalty-free license to use such technical data only for government purposes during the period commencing with contract award and ending five years after completion of the project under which the data were generated. Upon expiration of the five-year restrictive license, the government has unlimited rights in the STTR data. During the license period, the government may not release or disclose STTR data to any person other than its support services contractors except: (1) For evaluational purposes; (2) As expressly permitted by the contractor; or (3) A use, release, or disclosure that is necessary for emergency repair or overhaul of items operated by the government. See FAR clause 52.227-20, "Rights in Data - SBIR Program" and DFARS 252.227-7018, "Rights in Noncommercial Technical Data and Computer Software -- SBIR Program."

5.10 Cost Sharing

Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of any Phase I proposal.

5.11 Joint Ventures or Limited Partnerships

Joint ventures and limited partnerships are eligible provided the entity created qualifies as a small business as defined in Section 2.3 of this solicitation.

5.12 Research and Analytical Work

For Phase I and II, a minimum of 40 percent of the research and/or analytical effort must be performed by the proposing firm and a minimum of 30 percent performed by the research institution unless otherwise approved in writing by the contracting officer. The percentage of work is usually measured by both direct and indirect costs; however, proposers should verify how it will be measured with their contracting officer during contract negotiations.

5.13 Contractor Commitments

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulations that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

a. Standards of Work. Work performed under the contract must conform to high professional standards.

b. Inspection. Work performed under the contract is subject to government inspection and evaluation at all

reasonable times.

c. Examination of Records. The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.

d. Default. The government may terminate the contract if the contractor fails to perform the work contracted.

e. Termination for Convenience. The contract may be terminated at any time by the government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.

f. Disputes. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.

g. Contract Work Hours. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).

h. Equal Opportunity. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

i. Affirmative Action for Veterans. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era.

j. Affirmative Action for Handicapped. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.

k. Officials Not to Benefit. No member of or delegate to Congress shall benefit from the contract.

l. Covenant Against Contingent Fees. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.

m. Gratuities. The contract may be terminated by the government if any gratuities have been offered to any representative of the government to secure the contract.

n. Patent Infringement. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.

o. Military Security Requirements. The contractor shall safeguard any classified information associated with the contracted work in accordance with

applicable regulations.

p. American Made Equipment and Products. When purchasing equipment or a product under the STTR funding agreement, purchase only American-made items whenever possible.

5.14 Contractor Registration [NEW]

Before DoD can award a contract to a successful proposer under this solicitation, the proposer must be registered in the DoD Central Contractor Registration database. To register, see <http://www.ccr2000.com/> or call 1-888-227-2423.

5.15 Additional Information

a. General. This Program Solicitation is intended for information purposes and reflects current planning. If there is any inconsistency between the information contained herein and the terms of any resulting STTR contract, the terms of the contract are controlling.

b. Small Business Data. Before award of an STTR contract, the government may request the proposer to submit certain organizational, management, personnel, and financial information to confirm responsibility of the proposer.

c. Proposal Preparation Costs. The government is not responsible for any monies expended by the proposer before award of any contract.

d. Government Obligations. This Program Solicitation is not an offer by the government and does not obligate the government to make any specific number of awards. Also, awards under this program are contingent upon the availability of funds.

e. Unsolicited Proposals. The STTR Program is not a substitute for existing unsolicited proposal mechanisms. Unsolicited proposals will not be accepted under the STTR Program in either Phase I or Phase II.

f. Duplication of Work. If an award is made pursuant to a proposal submitted under this Program Solicitation, the contractor will be required to certify that he or she has not previously been, nor is currently being, paid for essentially equivalent work by an agency of the Federal Government.

g. Classified Proposals. If classified work is proposed or classified information is involved, the offeror to the solicitation must have, or obtain, security clearance in accordance with the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M). The Manual is available on-line at <http://www.dis.mil> or in hard copy from:

Defense Investigative Service
1340 Braddock Place
Alexandria, VA 22314
Phone: (703) 325-5324

6.0 SUBMISSION OF PROPOSALS

An original plus (4) copies of each proposal or modification will be submitted, in a single package, as described below, unless otherwise stated by specific instructions in Section 8.0.

NOTE: EACH PROPOSAL MUST CONTAIN A COMPLETED PROPOSAL COVER SHEET AND COMPANY COMMERCIALIZATION REPORT (see Section 3.4b and n).

6.1 Address

Each proposal or modification thereof shall be submitted in sealed envelopes or packages addressed to the DoD Component address which is identified for the specific topic in that Component's subsection of Section 8.0 of this solicitation.

The name and address of the offeror, the solicitation number, the topic number for the proposal, and the time and date specified for proposal receipt must be clearly marked on the face of the envelope or package. To protect your proposal against rough handling, damage in the mail, and the possibility of unauthorized disclosures, it is recommended that your proposal be double-wrapped and that both the inner and outer envelopes or wrappings be clearly marked.

Offerors using commercial carrier services shall ensure that the proposal is addressed and marked on the outermost envelope or wrapper as prescribed above.

Mailed or handcarried proposals must be delivered to the address indicated for each topic. Secured packaging is mandatory. The DoD Component cannot be responsible for the processing of proposals damaged in transit.

All copies of a proposal must be sent in the same package. Do not send separate information copies or several packages containing parts of the single proposal.

6.2 Deadline of Proposals

Deadline for receipt of proposals at the DoD Component is 3:00 p.m. local time, April 12, 2000. Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before an award is made, and:

(a) it was sent by registered or certified mail not later than April 5, 2000;

(b) it was sent by mail or hand-carried (including delivery by a commercial carrier) and it is determined by the Government that the late receipt was due primarily to Government mishandling after receipt at the Government installation; or

(c) it was sent by U.S. Postal Service Express Mail Next Day Service-Post Office to Addressee, not later than 5:00 p.m. at the place of mailing on April 10, 2000.

Note: There are no other provisions for late receipt of proposals under this solicitation.

The only acceptable evidence to establish the date of mailing of a late proposal sent either by registered or certified mail is the U. S. Postal Service postmark on the envelope or wrapper and on the original receipt from the U.S. Postal Service. Both postmarks must show a legible date or the proposal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U. S. Postal Service on the date of mailing. Therefore, offerors or respondents should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper. Acceptable evidence to establish the time of receipt at the Government installation includes the time/date stamp of the installation on the proposal wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel. The only acceptable evidence to establish the date of mailing of a late proposal sent by Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on both the envelope or wrapper and on the original receipt from the U.S. Postal Service. Therefore, offerors should request the postal clerk to place a legible hand cancellation bull's eye postmark on both the receipt and the envelope or wrapper.

Proposals may be withdrawn by written notice or a telegram received at any time prior to award. Proposals may also be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal. (Note: the term telegram includes mailgrams.)

Any modification or withdrawal of a proposal is subject to the same conditions outlined above. Any modification may not make the proposal longer than 25 pages (excluding Company Commercialization Report). Notwithstanding the above, a late modification of an otherwise successful proposal which makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

6.3 Notification of Proposal Receipt

Proposers desiring notification of receipt of their proposal must complete and include a self-addressed stamped envelope and a copy of the notification form (Reference D) in the back of this brochure. If multiple proposals are submitted, a separate form and envelope is required for each. Notification of receipt of a proposal by

the government does not by itself constitute a determination that the proposal was received on time or not. The determination of timeliness is solely governed by the criteria set forth in Section 6.2.

6.4 Information on Proposal Status

Evaluation of proposals and award of contracts will be expedited, but no information on proposal status will be available until the final selection is made. However, contracting officers may contact any and all qualified proposers prior to contract award.

6.5 Debriefing of Unsuccessful Offerors

An unsuccessful offeror that submits a written request for a debriefing within 30 days of being notified that its proposal was not selected for award will be provided a debriefing. The written request should be sent to the DoD organization that provided such notification to the offeror. Be advised that an offeror that fails to submit a timely request is not entitled to a debriefing, although untimely debriefing requests may be accommodated at the government's discretion.

6.6 Correspondence Relating to Proposals

All correspondence relating to proposals should cite the STTR solicitation number and specific topic number and should be addressed to the DoD Component whose address is associated with the specific topic number.

7.0 SCIENTIFIC AND TECHNICAL INFORMATION ASSISTANCE

7.1 DoD Technical Information Services Available

The Defense Technical Information Center (DTIC), provides information services to assist STTR participants in proposal preparation, bid decisions, product development, marketing and networking. The following services are available at no cost. See the DTIC SBIR/STTR web site (<http://www.dtic.mil/dtic/sbir>) for additional information.

1. **Public STINET**, DTIC's online technical database, is on the web site. STTR participants are encouraged to search the database for documents in their areas of interest.
2. **TRAIL** (<http://www.dtic.mil/trail>) an e-mail document alert service available to SBIR/STTR participants, provides listings biweekly of new DTIC accessions matching the recipient's interest.
3. **Free Reports**: A firm may receive a total of ten hard copy technical reports at no cost from DTIC during an SBIR/STTR solicitation period. Additional reports and services may be charged to a credit card or deposit account.
4. **SITIS**, providing answers to specific technical questions concerning DoD topic descriptions, is also on the web site. See the description of SITIS in Section 1.5.c.

DTIC is a major component of the DoD Scientific and Technical Information Program, managing the technical information resulting from DoD-funded research and development (<http://www.dtic.mil>). DTIC also manages and provides access to specialized information services and subject matter expertise. MATRIS, a DTIC component, is the focal point for information on manpower, training systems, human performance, and human factors (<http://dticam.dtic.mil>). The DTIC-managed Centers for Analysis of Scientific and Technical Information (the IACs) are the DoD centers of expertise concerned with engineering, technical and scientific documents and databases worldwide (<http://www.dtic.mil/iac/>).

Call, or visit (by pre-arrangement), DTIC at the location most convenient to you. Written communication should be made to the Ft. Belvoir address.

ATTN: DTIC-SBIR
Defense Technical Information Center
8725 John J Kingman Rd, Suite 0944
Ft Belvoir VA 22060-6218
Phone (800) 363-7247
Fax (703) 767-8228
EMail sbir@dtic.mil
WWW <http://www.dtic.mil/dtic/sbir>

ATTN: DTIC-BRNB
DTIC Northeastern Regional Office
Building 1103
5 Wright Street
Hanscom AFB, MA 01731-3012
Ph: (781) 377-2413
Fax: (781) 377-5627
Email: boston@dtic.mil

ATTN: DTIC-BRND
DTIC Midwestern Regional Office
Bldg. 196, Area B
2261 Monahan Way
Wright-Patterson AFB, OH 45433-7022
Ph: (937) 255-7905
Fax: (937) 656-7002
Email: dayton@dtic.mil

ATTN: DTIC-BRNL
DTIC Western Regional Office
Bldg. 80
2420 Vela Way, Suite 1467
El Segundo, CA 90245-4659
Ph: (310) 363-8980
Fax: (310) 363-8972
Email: losangel@dtic.mil

DTIC Southwestern Regional Office
ATTN: DTIC-BRNA
AFRL-PSO/TL
3550 Aberdeen Ave, SE
Kirtland AFB, NM 87117-5776
Ph: (505) 846-6797
Fax: (505) 846-6799
Email: albuq@dtic.mil

7.2 DoD Counseling Assistance Available

Small business firms interested in participating in the STTR Program may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States. These specialists are available to discuss general administrative requirements to facilitate the submission of proposals and ease the entry of the small high technology business into the Department of Defense marketplace. The small and disadvantaged business utilization specialists are expressly prohibited from taking any action which would give an offeror an unfair advantage over others, such as discussing or explaining the technical requirements of the solicitation, writing or discussing technical or cost proposals, estimating cost or any other actions which are the offerors responsibility as outlined in

this solicitation. (See Reference E at the end of this solicitation for a complete listing, with telephone numbers, of Small and Disadvantaged Business Utilization Specialists assigned to these activities.)

7.3 State Assistance Available

Many states have established programs to provide services to those small firms and individuals wishing to

participate in the Federal STTR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to STTR recipients;
- Assistance in obtaining Phase III funding.

Contact your State Government Office of Economic Development for further information.

8.0 TECHNICAL TOPICS

Section 8 contains detailed topic descriptions outlining the technical areas in which DoD Components request proposals for innovative R&D from small businesses. Topics for each participating DoD Component are listed and numbered separately. A number of Army, Navy and Air Force topics either are authored by a DoD acquisition program (e.g., New Attack Submarine, Abrams Tank) or are of significant interest to such a program, as noted in the text of the topic. These acquisition programs are potentially important end customers for innovative new products resulting from SBIR projects. Information on how to contact these programs is posted on the Web Site (<http://www.acq.osd.mil/sadbu/sbir/acqprog/liaisons.htm>).

Each DoD Component Topic Section contains topic descriptions, addresses of organizations to which proposals are to be submitted, and special instructions for preparing and submitting proposals to organizations within the component. Read and follow these instructions carefully to help avoid administrative rejection of your proposal.

<u>Component Topic Sections</u>	<u>Pages</u>
Army	ARMY 1-9
Navy	NAVY 1-14
Air Force	AF 1-16
Defense Advanced Research Projects Agency	DARPA 1-11
Ballistic Missile Defense Organization	BMDO 1-11

Many of the topics in Section 8 contain references to technical literature or military standards, which may be accessed as follows:

- References with "AD" numbers are available from DTIC, by calling 800/DoD-SBIR or sending an e-mail message to sbir@dtic.mil
- References with "MIL-STD" numbers are available from the Department of Defense Single Stock Point for Military Specifications, Standards and Related Publications at Internet address <http://www.dtic.mil/stinet/htgi/dodiss>
- Other references can be found in your local library or at locations mentioned in the reference.

ARMY

Submission of Proposals

The responsibility for the implementation, administration, and management of the U.S. Army Small Business Technology Transfer (STTR) Program rests with the Army STTR Program Manager at the U.S. Army Research Office (ARO). You are invited to submit STTR proposals to ARO at the US Postal or physical addresses below. Proposals must be received at ARO no later than the required solicitation closing date and hour. Instructions in the Solicitation are augmented with these specific Army requirements.

Physical Address for Private Delivery Services

U.S. Army Research Office
ATTN: STTR-2000 (LTC Jones)
4300 South Miami Blvd
Durham, NC 27703-9142
Telephone: 919-549-4200

Mailing Address for U.S. Postal Service

U.S. Army Research Office
ATTN: STTR-2000 (LTC Jones)
P.O. Box 12211.
Research Triangle Park, NC 27709-2211

The Army has identified eight topics, numbered ARMY00-T001 through ARMY00-T008, to which small businesses and their partner research institutes may respond. Only proposals addressing these topics will be accepted for consideration for Phase I of the Army STTR Program.

The Army anticipates sufficient funding to allow award of one to three STTR Phase I contracts to firms submitting the highest quality proposals in each topic area. Awards will be made on the basis of technical evaluations using the criteria contained in the solicitation within the bounds of STTR funds available to the Army at the time of award. If no proposals in a topic merit award relative to the proposals received in other topics, the Army will not award any contracts for that topic.

Proposals for Phase I are limited to a maximum of \$100,000 over a period not to exceed six months.

Based upon the progress during a Phase I contract, a firm may be invited to propose Phase II. Any Phase II contracts resulting from Phase I proposals submitted for this solicitation will be limited to a maximum of \$500,000 over a period of two years. Phase II contracts will be structured as a single year contract with a one year option.

Army STTR 00 Topic Descriptions

ARMY00-T001

TITLE: A Polyphosphazene-Based Membrane-Electrode Assembly for a Direct Methanol Fuel Cell

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM Soldier

OBJECTIVE: Using a polyphosphazene-based cation-exchange polymer, develop a membrane-electrode assembly for use in a direct methanol fuel cell (DMFC) that exceeds state-of-art performance of presently employed perfluorosulfonated materials. Although not the focus of this solicitation, a long-term objective is to develop a 10-50 W/1000Wh DMFC power system for the dismounted soldier.

DESCRIPTION: The Army, and particularly the Dismounted Soldier, has need for high-energy, lightweight power sources. Polymer electrolyte membrane fuel cells (PEM FCs) are candidates to fill these needs. Hydrogen-air fuel cells (H/A FC) based upon perfluorosulfonated ionomer (PFSI) membranes (e.g., Nafion[®]) have been developed to the point where they can augment the soldier's power needs, but lack of a convenient, inexpensive, and safe source of hydrogen is a significant impediment to their use. Methanol, in direct electrochemical combustion, is an alternative fuel for which these difficulties do not exist, but the power density of a DMFC is below that of an H/A FC. One cause of the lower power density originates from methanol crossover through the PFSI PEM from the anode to the air cathode. New, less-methanol permeable PEMs are required to improve the performance of a DMFC (1, 2). Polyphosphazene-based, cation-exchange membranes show promise in this application. For example, a sulfonated and crosslinked polyphosphazene membrane has a conductivity approximately half that of Nafion 117, but with a methanol permeability approximately a factor of ten less (3).

PHASE I: Develop processes to fabricate a viable membrane-electrode assembly (MEA) for an air-fed DMFC using a polyphosphazene-based, cation-exchange polymer and evaluate these MEAs in a single-cell arrangement. Performance must exceed state-of-art PFSI-based DMFCs. Identify and discuss the critical issues in developing a low-cost, efficient manufacturing process to produce viable polyphosphazene-based MEAs.

PHASE II: Address the critical processing issues identified in Phase I to produce polyphosphazene-based MEAs. Develop a "benchtop" 10-50 W DMFC cell stack using these MEAs. Identify and address system issues that are unique to the polyphosphazene-based DMFCs such as thermal and water management.

PHASE III DUAL USE COMMERCIALIZATION: Developments in DMFC power sources will have immediate impact on a wide range of commercial power sources from computer power to emergency medical power supplies to recreational power uses.

REFERENCES:

- 1) C. Martin and D. DesMarteau, "Advanced PEM fuel cell membranes and membrane-electrode assemblies for non-conventional fuels," ARO Workshop Report, Clemson University (1999).
- 2) B.S. Pivovar, Y. Wang, and E.L. Cussler, J. Membrane Sci., 154 (1999) 155-162.
- 3) Q. Guo, P.N. Pintauro, H. Tang, and S. O'Connor, J. Membrane Sci., 154 (1999) 175-181.

KEY WORDS: Fuel cell, direct methanol fuel cell, membrane-electrode assembly, polyphosphazene, soldier power

ARMY00-T002

TITLE: 3D Woven Composites for New and Innovative Impact and Penetration Resistant Systems

TECHNOLOGY AREAS: Materials/Processes, Human Systems

OBJECTIVE: To develop innovative methodologies and techniques for the use of 3D woven composites for significantly new and improved structural and mechanical applications pertaining to penetration and impact resistance. Reliable processing techniques for matrix resin application and optimization of 3D woven architectures for textile woven composites that can be tailored to resist and mitigate penetration are to be developed. Experiments and computational tools should be used to determine overall strength and response of these systems under impact loading conditions for the development of reliable design guidelines for new and significantly improved high strength and low-weight applications, such as body armor, structural systems, and mechanical components.

DESCRIPTION: Three-dimensional woven fibrous assemblies are textile architectures having fibers oriented along the three surfaces of a unit cell. The lack of kinematic constraints can allow the processing of novel composite architectures with desired thermo-mechanical response. In 3D woven structures, fibers are intertwined, interlaced or intermeshed in the cross-wise, lengthwise, and thickness directions. Recent automated manufacturing techniques have substantially reduced costs and significantly improved the potential for large-scale production. 3D textile woven composites, processed to date, have shown impressive multi-directional strength characteristics for structural and mechanical applications under quasi-static loading

conditions. However, optimal orientations and distributions of warp, web, fill, and surface yarns, resin types and infiltration techniques, and preform geometries have yet to be fully developed and perfected for 3D woven composites subjected to impact loading conditions. Once optimal combinations of these variables can be determined, new methodologies can be further developed on how to utilize inherent mechanisms of 3D woven composites for energy dissipation and strengthening.

PHASE I: Demonstrate the feasibility of tailored 3D textile composite architectures by using dynamic experiments and computational tools to determine response as a function of 3D woven fabrics, fiber orientations, distributions, and volume fractions, resin types, and preforms. These interrelated tools should be used in conjunction with cost-effective processing techniques to determine optimal 3D textile composite architectures. Comparisons with 2D woven architectures should be undertaken, as a benchmark, to assess performance and durability, and to delineate advantages of 3D woven systems. Prototype designs that can be efficiently processed fabricated, and tailored to resist high velocity impact and penetration should be developed.

PHASE II: Prototype designs from Phase I should be specialized to a specific structural and mechanical application, such as body armor protection vests, helmets, or structural components that can be efficiently manufactured. Experiments and computational tools should be used to assess and evaluate the durability and performance of these designs to realistic threats and dynamic loading conditions. Reliable guidelines should be then be developed for the design, processing, and fabrication of these prototypes for batch production.

PHASE III DUAL USE COMMERCIALIZATION: There are a large number of dual use applications. 3D woven textile architectures can be used for high strength, lightweight, and damage tolerant applications, such as body armor (vests, helmets, soles for anti-mine shoes), bomb containment devices, and as structural elements and components in military and commercial vehicles, off shore marine platforms, shelters, automotive and marine components, and hardened structures.

KEYWORDS: 3D textile composite architectures, impact and penetration, fiber volume fractions, 3D fabrics, preforms, energy dissipation mechanisms, resin techniques

REFERENCES:

1. V.R. Aitharahju, and R.C. Averill, "Three-Dimensional Properties of Woven-Fabric Composites," Composites Science and Technology, Vol. 59 no. 12, p. 1901, 1999.
2. G. Zhu, W. Goldsmith, and C.K.H. Dharan, "Penetration of Laminated Kevlar by Projectiles-I, Experimental Investigation," International Journal of Solids and Structures, Vol. 29, no. 4, p. 399, 1992.

ARMY00-T003

TITLE: High Strength, Damage Tolerant Structures From Novel Layer Geometries

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: To develop structural components with layer geometries specifically designed to increase the strength and damage tolerance properties under complex loading conditions, and to develop computationally and experimentally optimized design guidelines for the layer geometries in these components.

DESCRIPTION: Research in metallic, ceramic, polymeric, and composite layered materials has often demonstrated an increased strength and fracture toughness of these materials compared to their homogeneous or non-layered equivalents; the mechanisms identified to explain these increased mechanical properties include crack deviation and interfacial debonding. Recent preliminary work has demonstrated the further advantage of materials with a corrugated laminate geometry for increased penetration resistance (i.e., K.S. Vecchio). It has therefore been demonstrated that not only the layering of materials, but also the geometry of these layers, has a significant impact on the mechanical properties of the resulting structures; it is expected that materials with novel layer geometries could be optimized for improved strength/performance to weight ratios and damage tolerance properties. Such materials would be highly relevant to the Army's interest in developing lightweight and damage tolerant vehicles and structures. What is desired is: (1) development of the synthesis and processing technology required for the low-cost fabrication of structures utilizing advanced layer geometries for increased strength and damage tolerance, (2) an integrated experimental and computational characterization of the influence of layer geometry on the strength and damage tolerance (i.e., deformation, fracture, fatigue, etc.) of these structures, and (3) the establishment of optimal, and preferably tunable, design parameters for structures with maximum strength and damage tolerance.

PHASE I: Demonstrate the fabrication of a representative component and the optimization of its strength and damage tolerance properties via novel layer geometry in order to evaluate the potential for the production of a complex component for DOD and commercial applications. The critical processing steps should be identified and the preliminary materials characterization and testing (both experimental and computational) should be performed.

PHASE II: Conduct additional experimental and computational characterizations as required, and document expected strength, performance, and damage tolerance capabilities and projected cost savings. Demonstrate the technological advances achieved in strength and damage tolerance via the production of a prototype component with optimized layer geometry.

PHASE III DUAL USE COMMERCIALIZATION: Incorporate structural components with optimized layer geometry into aircraft, rotorcraft, road, rail, or other transportation vehicles or systems in order to improve strength/performance to weight ratios and damage tolerance properties. Optimize the process and component design for fabrication on a plant scale. For DOD,

these materials could provide enhanced strength/performance to weight ratios and damage tolerance properties in order to lighten forces and increase functionality under complex loading conditions. Materials incorporating novel layer geometries could also serve as replacements for commercial transportation systems and even sports equipment.

KEY WORDS: Layer geometry, fabrication, high strength, damage tolerance

ARMY00-T004

TITLE: Hand-held and Head-mounted Microdisplays for the Dismounted Soldier

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: To take advantage of recent developments in "microdisplays," which have very high resolution, are about 0.75 inch cube in size, are robust, have full color, and consume very little power. These can be adapted to the needs of the individual soldier both as hand-held and head-mounted display units, for the soldier to communicate with Command Control Communication headquarters while on the move. Bringing together recent S&T advances in visual Displays adapted to the needs of the Land Warrior, this STTR effort will provide a springboard for advancements towards "Future Operational Capabilities" (FOCs) being advocated by TRADOC (Training and Doctrine Command). In addition, it will show new pathways for advanced civilian applications through promotion of the related R&D, and will advance civilian commerce.

DESCRIPTION: Recently, liquid crystal and electroluminescent versions of microdisplays have been produced that together with other advances in materials science show the potentiality of meeting the display requirement for the individual soldier. Specifically, liquid crystal and electroluminescent science has progressed to a point that these advances need to be configured into such displays, and assessed with regard to the overall Land Warrior System. Among the advances is a class of liquid crystal materials that have been produced which are immune to exposure to extremes in the military range of temperatures, and others which can produce analogue gray scales. It is also necessary to integrate these advances with RF signal processing components to craft a system that the soldier can use. The time is right to integrate such advances first into a hand-held version and thereafter into a helmet-mounted display (HMD) for the Land Warrior that is compatible with his/her helmet-mounted night vision means as well.

PHASE I: Via an interdisciplinary research effort develop materials for display that will satisfy operational capability requirements detailed below for microdisplays for the Land Warrior. The RF requirements, power consumption limits, information throughput rate, security in communication, robustness to shock and temperature variation over the military range, and compatibility with other systems requirements for the soldier in the battlefield will be investigated, quantified, and display materials will be developed accordingly. Already at this stage, the materials to be developed will have to be able to function in a "display system" having optimal properties with respect to: a) Total weight including cabling for RF communication and power; b) Storage and operability over the military temperature range; c) Pixel density/resolution needed for carrying out battlefield functions including viewing, reception and transmission of imagery and symbology; d) See-through versus occluded vision constraints and field of view; e) "Stow-ability" of imagery/information for future at-will use; f) Immunity to shock levels expected to be encountered by the dismounted warrior; g) Compatibility with night vision devices mounted on helmet, compatibility with RF components for communication with "buddies" and upper echelons. For guidance on quantitative values that satisfy TRADOC requirements, see TRADOC documents at web site: <http://www-tradoc.army.mil>.

PHASE II: Develop, based on the results/conclusions of Phase I, two prototype deliverable microdisplay systems. The first deliverable should be a palm-sized hand-held microdisplay communication system for the soldier on the move. Based on this work, a helmet-mounted version will be developed that pays attention to: human vision and ergonomic requirements, such as proximity to the eye, field of view, being easily retractable and removable, and consistency with other optics such as those for night vision. Details of operational parameters will be mapped out and the efficacy of the units to perform battlefield functions will be assessed, in collaboration with Army PM/POCs as assigned.

PHASE III DUAL USE COMMERCIALIZATION: Civilian/commercial applications will ensue. Such an information delivery system is useful, particularly with regard to large scale manufacturing operations in factories where operators are on the move. A top official at Boeing Aircraft Co has articulated a well-established example to us. Scheduling steps on their "big board" are followed though by in-plant moving personnel who need to visualize the state of development of components as these are assembled into an aircraft entity being formed. Numerous other scenarios are evident. There is a very large market for head-mounted display communication system such as the one described above.

REFERENCES: Integrated Helmet Assembly Subsystem (IHAS) description under Land Warrior web pages: <http://www.sbccom.army.mil/programs/lw> and TRADOC publications under the TRADOC web page: <http://www-tradoc.army.mil>.

KEY WORDS: The key words are in categories as follows: a) TRADOC's Future Operational Capabilities (FOC), Army 2010, Land Warrior Program, soldier systems, dismounted warrior; b) Situation awareness, owning both the day and the night, information dominance, web-centric sensor and communication nets; c) Microdisplays, Helmet Mounted Displays (HMD), electroluminescence; liquid crystals, spatial light modulators, gray scales, digital versus analogue displays; d) Symbology; secure communication; command control centers on the move, communication with higher echelons by the Land Warrior.

ARMY00-T005

TITLE: Novel, Low-Cost Processing Of Functionally Gradient Ceramic-Matrix, Metal-Matrix Composite Materials

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: To develop a processing operation, or a sequence of processing operations, to produce a low cost, functionally gradient ceramic-matrix and metal-matrix composite component.

DESCRIPTION: The desirable properties of ceramic-matrix composites (CMCs) for many applications are mitigated by their high costs and difficulty to produce as defect free structural components. The production of CMCs as liners and coatings has been demonstrated, but suffers problems with bonding to metallic substrates and assembly without damage to the liner. Continuous filament, metal-matrix composites (MMCs) have been produced by a number of techniques in complicated, near-net-shape forms. Though these have significantly improved stiffness and strength over the base metals, they are still not suitable for high wear, high temperature or chemical resistance applications that would call for a CMC. Combining the two materials into a functionally gradient system that would place the CMC in regions of high temperature, wear and/or corrosion while supported by a MMC for structural integrity, light weight and lower cost would produce a new material system with much greater commercial possibilities. This should be accomplished by combining processing techniques that are either mutually compatible or complementary in nature, but have been proven feasible on an industrial scale. In addition, engineering design issues associated with the material system and component should be investigated to determine potential problems caused by the combination of properties and to optimize performance. A typical materials system of interest would be SiC reinforced aluminum alloy tube, coupled with a SiC reinforced SiC tube liner as a potential lightweight gun tube.

PHASE I: A process sequence consisting of: 1) braiding/weaving of a tubular SiC fibre preform; 2) chemical vapour infiltration with SiC from the inside of the tube to form a fully dense inner liner; 3) vacuum assisted, pressure infiltration casting of a structural aluminum alloy from the outside to form a near-fully dense outer shell with no trapped porosity. The size of the tube shall be at a minimum of 20mm inner diameter and a maximum of 155mm inner diameter, with a minimum acceptable wall thickness of 7mm. The minimum acceptable tube length will be 70mm and the maximum included pore size in the part will be 150mm.

PHASE II: At least four test articles of specification described above will be produced. One test article will be burst-tested to failure. The results will be compared to an article of identical dimensions made from a D6AC tool steel tempered to Rc57. The second test article shall be subjected to an ASTM standard hot-gas erosion test. The results will be compared to the performance of a 4340 steel, tempered to and Rc50 and hard-chrome plated to a thickness of 300mm. The third sample will be subjected to thermal shock cycling (350oC to -15 oC in 1.5 sec) to failure (max 103 cycles). The fourth sample shall be held in reserve. A cost analysis shall be performed to estimate the cost of production of 155mm gun tubes. As part of the estimate, the reduction of weight of the gun tube should be estimated and the impact of this reduced weight on the cost of transporting the gun system should be estimated. Finally, the expected life of the gun tube should be estimated from the test data generated above.

POTENTIAL COMMERCIAL MARKET: Defense: Functionally gradient armour materials; light weight, high performance gun tubes for medium and large bore applications; high performance bearing races. Commercial: High temperature, corrosion and erosion resistant parts for the chemical industry such as pipes, valve bodies, heat transfer tubes and etc.

ARMY00-T006

TITLE: Individual Protection Against Nerve Agents

TECHNOLOGY AREAS: Biomedical

OBJECTIVE: To covalently attach enzymes that degrade nerve agents and pesticides to surfaces and skin.

DESCRIPTION: The toxicity of organophosphorus nerve agents results from their penetration through the epidermis and their entry into the general circulation, from which they can reach the nervous system. To deal with this problem, protective clothing has been developed in numerous forms. The potential utility of enzymes and biocatalysis in the detoxification of contaminated surfaces is widely accepted.^{1,2} Naturally occurring organophosphorus hydrolases are being incorporated into external protection systems to hydrolyze chemical agents. An alternative to incorporating the nerve agent-degrading enzymes into protective clothing would be to directly attach the enzymes to the surface of the warfighter's skin.

Methods of coupling enzymes to the skin, the entry point into the body, are the key obstacles in developing this technology. The enzymes need be coupled to the skin or other materials through covalent bonds that are resistant to washing with detergent. The enzyme must be coupled to surfaces (skin or otherwise) with chemistry or a linker that does not adversely impair the activity of the nerve agent-degrading enzyme.

PHASE I: Develop a covalent linking system and the necessary chemistry for attaching to the skin enzymes that degrade nerve agents. Show that the nerve agent-degrading enzyme is active in vitro after the linker has been attached and show that the linking chemistry does not denature the enzyme. If it is active, then attach the nerve agent-degrading enzyme to cornified layers of discarded human skin and show that the enzyme is still active against nerve agents.

PHASE II: Optimize the conditions for attachment and simplify the system for delivering the enzyme with its linker and the coupling enzyme by spraying or painting. Test animals (nude mice or rats) for protection by applying the new enzyme system and exposing them to nerve agent.

PHASE III DUAL-USE COMMERCIALIZATION: Phase III includes further identification and development of conditions for utilization of the protective enzyme systems. The catalytic activity and substrate selectivity of enzymes make them interesting catalysts for a broad variety of industrial and commercial processes. The similarity of chemical agents to commercially important organophosphorus products means that the techniques developed in this topic are directly applicable to industry. This technology would provide protection to persons exposed to pesticides in industry or to the public exposed to pesticides (golfers, etc.).

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KEY WORDS: chemical warfare agents, nerve agents, enzyme, decontamination, protection

ARMY00-T007

TITLE: Biomimetic Information Technology Systems (BITS)

TECHNOLOGY AREAS: Information Systems, Materials/Processes, Biomedical, Electronics, Battlespace

OBJECTIVE: The creation of biomimetic image information technology systems that can acquire optical images of the surrounding environment, process the information, and distribute the proper control responses throughout a tunable-signature material system.

DESCRIPTION: Intelligent information technology systems offer exciting new possibilities for conducting covert reconnaissance and surveillance activities and for a variety of specialized combat operations with an emphasis towards active camouflage control. Intelligent information technology systems typically consist of a dynamic network of agents interconnected via spatial and communications links that operate in uncertain and dynamically changing environments using decentralized or distributed inputs that may change over time. The agents may be sensors, information sources, or automated systems such as robots, software, and computing modules. The objective of the BITS development is an advanced system that is able to sense, analyze, learn, and provide information technology to an active camouflage system that allows it to adapt to the surrounding signatures in order to remain undetected by threat sensors in a changing or hostile environment. Examples of biological systems that exhibit this capability include chameleons and flat fish.

To accomplish this goal, BITS seeks to benefit from the direct manipulation of a process of biological origin or from engineered exploitation that derives a product mimicking a naturally occurring system. Biological systems have exquisite and highly integrated sensing capabilities that allow rapid and selective recognition and signal processing that can detect and classify targets, or the background signatures prevalent in cluttered environments. Information technology-based learning systems that are designed using biological principles offer the possibility of a new class of sensitive and rapid-response sensors.

Rapidly emerging advances in this area of scientific endeavor show substantial promise to affect a number of Army applications. The BITS must be capable of gathering relevant, available information about their environment, analyzing its significance in terms of assigned missions/functions, and defining the most appropriate course of action consistent with biomimetic decision logic. These objectives require the integration of significant scientific and technological advances in many diverse fields: physics, biology, cognitive and neural sciences, control theory and mechanisms, and systems engineering. Critical areas of research include the design and representation of hierarchical perception of targeted biological systems (chameleons or flat fish), advanced models for learning and adaptation, development of effective frameworks for representing and reasoning with uncertainty, and new computational paradigms for countering surveillance by human centered systems. The numerous potential military applications of intelligent systems include unmanned vehicles (air and ground), smart weapons, real-time C2 systems for future battlefields, and CB defense systems.

PHASE I: Develop an overall system design for optical sensors and neuromorphic processing algorithms for creating a chameleon-like system capable of masking a signature based on a 360-degree azimuth, 180-degree elevation threat viewpoints. The system should be able to sense the spectral and pattern characteristics of the environment it is located within and create a masking signature that effectively eliminates detection from any threat observation angle. The system should also outline how this processed sensor information would be spatially distributed to a cellular-array, materials system with signature shifting properties

PHASE II: Develop and fabricate an actual microsensing system complete with biomimetic image processing and feedback control. Neuromorphic processing similar to a chameleon must be demonstrated in a variety of natural environments and urban terrains. Conduct testing of the ability to sense, processes, and adapt to patterns based upon the actual environmental

stimuli and the current state-of-the-art spectral signature material system capabilities. Conduct testing to prove feasibility in both simulation and realistic environments over extended operating conditions.

PHASE III DUAL USE COMMERCIALIZATION: This system would have wide utility in domestic security and law enforcement applications in the camouflage of automated surveillance equipment surfaces for perimeter security. Long-term surveillance systems and observation posts operated by the border patrol and other high-security areas could be provided with sensor and signature-control materials to adjust the camouflage much like that of a chameleon. This type of camouflage control system could provide continuous adjustment to compensate for daily and seasonal variations in signature to provide the user with situational and operational awareness without compromising the sensors' location. Additional applications include an urban beautification project for large-scale active murals, neuromorphic feedback control for active noise cancellation systems, and smart windows control systems for the minimizing the energy budget of large facilities.

REFERENCES:

1. DoD: Strategic Research Objectives: http://www.sarda.army.mil/sard-zt/ASTMP98/vol_i/sec5/sec5b8.htm, Joint Vision 2010, pp 12 and 20; CAC&FLW Pam 525-05; Engineer Vision paragraph 3-2b(3)(a). TRADOC Pam 525-200-3; TRADOC Pam 525-5; TRADOC Pam 525-75; paragraphs 3-3g and 4-5g; TRADOC Pam 525-200-2; TRADOC Black Book No.4; CAC&FLW Pam 525-05.
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KEYWORDS: Biomimetic, Information Technology, Camouflage, Sensor, Signature, Adaptive, Chameleon, Surveillance

ARMY00-T008

TITLE: Coping Mechanism Assessment

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: To identify, test, and recommend technologies for developing the coping behaviors that enable individuals to deal with and avoid derailment by the difficulties encountered in completing long-term work obligations.

DESCRIPTION: Today's military is facing high rates of attrition by new soldiers who have volunteered to serve for a contracted period of time (e.g., four years). For the military, attrition creates the problems arising from non-programmed personnel turbulence. For the soldier, attrition means not meeting a work obligation that he or she agreed to and set out to achieve. There are varying reasons for attrition from the military. These reasons vary from fully involuntary (e.g., death or physical injury preventing job performance) to fully voluntary (e.g., desertion). However, most reasons fall somewhere between these extremes: academic failure, family hardship, adaptation to military life, prohibited activities (e.g., drug use), etc. Especially for those reasons with voluntary components, the reasons are also more (e.g., physical standards) or less (e.g., skill acquisition, accommodation to new social rules) unique to the military. Regardless, most new soldiers actually complete the length of their first term of service. In a number of areas, researchers and practitioners have sought to identify and promote development of the behaviors, strategies, or mechanisms which individuals successfully engage to cope with--solve, manage, or otherwise live through--the task, social, and emotional difficulties they encounter in completing work or other life pursuits. The methods for describing or otherwise measuring the coping behaviors for particular situations are open to question (e.g., Dewe, Cox, & Ferguson, 1993; O'Driscoll & Cooper, 1996). Regardless, social learning theory and its extension to self-regulation (Bandura, 1997; Wood & Bandura, 1989) are generally compatible with the hypothesized processes for goal achievement. Warehime's (1980) approach for conflict management training covered cognitive, emotional, and behavioral (actions) ways of responding to and handling conflict situations. Results for adults (Brandtstaedter & Renner, 1990) suggest that over time, responses to crises and critical life transitions may shift from an assimilative mode to an accommodative mode. The coping behaviors of specific groups have also been studied. With respect to military service members, Clemson (1996) investigated the coping skills of new recruits over the period of training for entry into service (boot camp). Relevant here is the finding (Simutis, Ward, Harman, Farr, & Kern, 1988) that soldiers eligible for, voluntarily undertaking, and successfully completing a remedial education program in basic academic skills were more likely to complete their initial terms of service than were eligible soldiers who elected not to participate. Further investigation of coping behaviors seems to have promise for the military and other organizations when focused on preventing new members from dropping out and on aiding them to complete the work obligations which they agreed to undertake.

PHASE I: In this phase, the research will focus on the reasons that new service members attrit or leave before completing the full length of their first obligation. These reasons will be examined to set forth the situational stresses and problems associated with the attrition decision. Consideration will be given to the generality of the problems across organizations and to their contribution to the rates of first-term attrition from military service. These problems will also be assessed against the literature to identify the types of coping skills, strategies or behaviors likely effective in solving, managing, or accommodating to the problems and, thereby, promoting completion of the first obligation. The literature assessment will take into account the procedures which organizations could use to train, develop, or otherwise support engagement in the coping behaviors. Based on this review, recommendations will be made of the framework of coping behaviors, skills, or strategies that is likely most useful for promoting service members' completion of their initial obligations. Procedures will also be proposed for measuring the

behaviors, for developing the behaviors in first-term service members, and for empirically testing the effects of the behaviors on service continuation.

PHASE II: The proposals for the measurement, intervention, and empirical testing will be implemented, if practical, using military service members (preferably U.S. Army) as research participants. As part of the validation of the measure or the intervention, test results are to indicate the relationships between coping behaviors, adaptation to the stresses and problems to which the behaviors respond, and attrition or completion of the first term of service. Based on test results, recommendations will be made about further development of training or other interventions for improving coping behaviors.

PHASE III DUAL USE APPLICATIONS: Even though developed with a focus on completion of military service, technologies for the measurement and training of coping behaviors for obligation completion would benefit other organizations. Especially benefited would be organizations with work requirements that are long term, stressful, and requiring persistence despite the situational and personal difficulties arising during performance over time.

KEYWORDS: attrition, commitment, goal attainment, self-regulation, coping behaviors/skills/strategies

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1. Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York: W.H. Freeman & Company.
2. Brandtstaedter, J., & Renner, G. (1990). Tenacious goal pursuit and flexible goal adjustment: Explication and age-related analysis of assimilative and accommodative strategies. *Psychology and Aging*, 5, 58-67.
3. Clemson, E.P. (1996). Monitoring anxiety levels and coping skills among military recruits. *Military Medicine*, 161, 18-21.
4. Dewe, P., Cox, T., & Ferguson, E (1993). Individual strategies for coping with stress at work: A review. *Work and Stress*, 7, 5-15.
5. O'Driscoll, M.P. & Cooper, C.L. (1996). A critical incident analysis of stress-coping behaviours at work. *Stress Medicine*, 12, 123-128.
6. Simutis, Z.M., Ward, J.S., Harman, J., Farr, B.J., & Kern, R.P. (1988). ARI research in basic skills education: An overview. ARI Research Report 1486. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
7. Warehime, R.G. (1980). Conflict-management training: A cognitive/behavioral approach. *Group and Organization Studies*, 5, 467-477.
8. Wood, R., & Bandura, A. (1989). Social cognitive theory of organizational management. *Academy of Management Review*, 10, 361-384.

NAVY STTR PROPOSAL SUBMISSION

INTRODUCTION:

The responsibility for the implementation, administration and management of the Navy STTR program is with the Office of Naval Research (ONR). The Navy STTR Program Manager is Mr. John Williams, (703) 696-0342. All STTR Phase I and Phase II proposals, Phase I and II printed electronic summary reports, as well as Phase III Success Stories should be forwarded to Mr. Williams at the address below. If you have any questions, problems following the submission directions, or inquiries of a general nature, contact Mr. Williams. All Phase I proposals are due by **12 April 2000** and must be submitted to:

Office of Naval Research
ATTN: Mr. John Williams, ONR 364 STTR
800 North Quincy Street
Arlington, VA 22217-5660

UNIQUE NAVY REQUIREMENTS:

1. The Navy requires a "DOD Proposal Cover Sheet" (formerly Appendix A & B) to be submitted electronically through the Navy SBIR/STTR Website or DOD SBIR/STTR Website at <http://www.dodsbir.net/sbirs submission>. The company must print out the forms directly from the Website, sign the forms and submit them with their proposal.
2. All Phase I award winners must electronically submit Phase I Summary Report(s) through the Navy SBIR /STTR Website at the end of their Phase I.
3. The Navy requires that all invited Phase II proposers submit a Proposal Cover Sheet and Commercialization Report through the DoD SBIR Submission Website. Mail a printed and signed copy of the Proposal Cover Sheet and Commercialization Report only to the Navy STTR Program Office listed above. Mail the full Phase II proposal with Proposal Cover Sheet and Commercialization Report to the sponsoring Navy activity and technical point of contact.
4. Phase II award winners must also submit Phase II summary reports through the Navy SBIR/STTR Website.
5. The requirements and time frames for Navy Fast Track submission have been modified and are described below.
6. The Navy only accepts proposals with a base effort not exceeding \$70,000 with an option not exceeding \$30,000. Phase I base effort should run about 6 months and the option 3 months.

NEW THIS YEAR:

1. The Small Business Administration (SBA) has made a determination that will permit the Naval Academy, the Navy Post-Graduate School and other military academies to participate as the research institution or subcontractor in the SBIR/STTR program, since they are institutions of higher learning.
2. The Navy will allow firms to include with their proposals success stories that have been submitted through the Navy SBIR/STTR Website at (<http://www.onr.navy.mil/sbir>). A Navy Success Story is any follow-on funds that the firm has received from a past Phase II Navy SBIR or STTR award. To qualify, the firm must submit these success stories no later than **15 March 2000**, through the Navy SBIR/STTR Website. The success story should then be printed and included as an appendix to the proposal. These pages will not be counted towards the 25-page limit. The success story information will be used as part of the evaluation of the third criteria, Commercial Potential (listed in Section 4.2 of this solicitation) which includes the Company Commercialization Report (formerly Appendix E) and the strategy described to commercialize the technology discussed in the proposal. Commercialization is viewed as any follow-on funds, from the DOD, DOD contractors or the private sector, used to further develop the technology or from sales of a product. The Navy is very interested in companies that transition SBIR/STTR efforts directly into Navy and DOD programs and/or weapon systems. If a firm has never received a Navy SBIR/STTR Phase II award, it will not count against them and they will be evaluated on the other evaluation criteria listed in Section 4.2 Phase I Evaluation Criteria. If you have any questions about this requirement, call John Williams at (703) 696-0342.

YOUR SUBMISSION TO THE NAVY STTR PROGRAM:

This solicitation contains a mix of topics. When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy technical point of contact (TPOC) during or at the end of a successful Phase I effort will be eligible to participate for a Phase II award (with the exception of Fast Track Phase II proposals per section 4.5). If you have been invited to submit a Phase II proposal to the Navy by the TPOC, obtain a copy of the Phase II instructions from the Navy SBIR/STTR Bulletin Board on the Internet or request the instructions from the Navy STTR Program Office. All Phase I and Phase II proposals should be sent to the Navy STTR Program Office (at the above address) for proper processing. Phase III efforts should also be reported to the STTR program office noted above.

The Navy will provide potential awardees the opportunity to reduce the gap between Phases I and II if they provide a \$70,000 maximum feasibility Phase I base proposal and a fully costed, well defined (\$30,000 maximum) Phase I option to the Phase I. **The Navy will not accept Phase I proposals in excess of \$70,000 (exclusive of the Phase I option).** The technical period of performance for the Phase I base effort should be 6 months and for the Phase I option should be 3 months. Plan for the 6 month awards to be made for the period of approximately June 1 through December 1. The Phase I option should be the initiation of the next phase of the STTR project (i.e. initial part of Phase II), and it must be included with the Phase I proposal. Please include brief task statements and milestones for the Phase I option, and include the costs on the same Cost Proposal, but in a separate column.

If you are invited to submit a Phase II proposal, it should consist of three elements: 1) a \$400,000 maximum demonstration phase of the STTR project; 2) a transition or marketing plan (formally called a "commercialization plan") describing how, to whom and at what stage you will market your technology to the government and private sector; 3) a Phase II option (\$100,000 maximum) which would be a fully costed and well defined section describing a test and evaluation plan for further R&D if the transition plan is evaluated as being successful. You must also submit your Phase II Cover Sheet & Company Commercialization Report electronically and mail a hard copy to the Navy STTR Program Office at the address above. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II option will be limited to 40 pages (unless otherwise directed by the TPOC or contract). The transition plan should be in a separate document.

The Navy will evaluate and select Phase I proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. The names of firms whose proposals have been selected for further consideration will be posted by topic number on the Navy SBIR/STTR Website, under "What's New", "STTR Selections", within 3 months of the proposal deadline. In addition, the abstracts of companies that have received Phase I awards will be posted on the website within 5 months of proposal deadline.

Phase I awardees should submit a 5-page preliminary plan for Phase II to the Navy STTR Program Manager at the address above, 5 months and 2 weeks after contract award. However, only those Phase I awardees which have been invited to submit a formal Phase II proposal by the TPOC will be eligible for a Phase II award (with the exception of Fast Track Phase II proposals per section 4.5). If you have been invited to submit a Phase II proposal to the Navy TPOC, get a copy of the Phase II proposal preparation and submittal guidelines from the Navy SBIR/STTR website.

ELECTRONIC SUBMISSION OF PROPOSAL COVER SHEET AND COMMERCIALIZATION REPORT:

Submit your DOD Proposal Cover Sheet (formerly Appendix A & B) and the DOD Commercialization Report (formerly Appendix E) to the Navy using the DOD online submission at <http://www.dodsbir.net/sbirs submission> and as discussed in Section 3.4b and 3.4n of this solicitation. This site allows your company to come in any time (prior to the closing of the solicitation) to edit or print out your appendices. **The Navy WILL NOT accept any forms from past solicitation books or any electronic download version except those from the DOD SBIR Website as valid proposal submission forms.** Detailed instructions can be found by selecting the Help button on this site once you have registered. If you have any questions or problems with the electronic submission contact the DOD SBIR Helpdesk at 1-800-382-4634.

ELECTRONIC SUBMISSION OF PROJECT REPORTS:

The submission of an electronic Phase I Summary Report will now be required at the end of Phase I. This Summary Report is submitted in addition to the full Phase I final report hard copy that is mailed to the address above. The Phase I Summary Report is a non-proprietary summary of Phase I results and should include potential applications and benefits and not exceed 750 words. It should require minimal work from the contractor because most of this information is required in the final report. The summary of the final report will be submitted through the Navy SBIR/STTR Website at: <http://www.onr.navy.mil/sbir>, click on "Submission", then click on "Submit a Phase I or II Summary Report".

NAVY FAST TRACK DATES AND REQUIREMENTS:

All Fast Track Applications and required information must be sent to the Navy STTR Program Manager at the address listed above and to the designated Contracting Officers Technical Monitor (the Technical Point of Contact (TPOC) for the contract and the appropriate Point of Contact at the end of this Introduction). The following dates and information are required by the company to qualify for the FAST TRACK program. All of the requirements listed in the Fast Track Section of the front of this solicitation must be met. The information provided below provides specific dates and some additional information that is required by the Navy STTR Program Office.

Party/Days After Phase I Award Required Deliverables

STTR Company / 150 Days	<ul style="list-style-type: none">- Fast Track Application and all supporting information. (See instructions in the DOD section of this Solicitation)- Phase II 5 Page Summary Proposal, as required of all Phase I Projects as described in Navy STTR Website listed above. (It is strongly recommended that if you are contemplating the submittal of a Fast Track Application, you make your intention known to your technical point of contact and the STTR Program Manager)- Request to initiate Phase I option (interim funding) which must have been included in the original Phase I proposal
Navy / 181 Days	<ul style="list-style-type: none">- Navy will initiate option funding if all requirements are met.
STTR Company /181 - 200 Days	<ul style="list-style-type: none">- Phase II Proposal- Phase I Final Report
Navy / 201 - 215 Days	<ul style="list-style-type: none">- Navy will formally Accept or Reject your Phase II proposal.
STTR Company /260 Days	<ul style="list-style-type: none">- Proof that Funding has been received by STTR company.

PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria must be met or your proposal will be **REJECTED**.

1. The Navy will not accept any proposals from companies that have not submitted the DOD Proposal Cover Sheet (formerly Appendix A & B) and the DOD Commercialization Report (formerly Appendix E) electronically over the Internet. After they are submitted electronically, these forms must be printed out directly from this site and be included with the entire proposal that is mailed to the Navy and received by 12 April 2000.
2. Your Phase I proposed cost for the base effort cannot exceed \$70,000. Your Phase I Option proposed cost cannot exceed \$30,000. The costs for the base and option should be clearly separate, and identified on the Proposal Cover Sheet, in the cost proposal, and in the work plan section of the proposal.
4. Your proposal must be received on or before the deadline date. The Navy will not accept late proposals or incomplete proposals. If you have any questions or problems with submission of your proposal, allow yourself time to contact the Navy or DoD SBIR Helpdesk and get an answer to your question. Submit electronic Internet forms early, as computer traffic increases, computer speed slows down. Do not wait until the last minute.

NAVY STTR 00 TOPIC DESCRIPTIONS

N00-T001

TITLE: High-Gain Amplifier Technology for a High Data-Rate Digital Link

TECHNOLOGY AREAS: Materials/Processes, Electronics

OBJECTIVE: Develop an amplifier technology for low-noise amplification of low-level, high-speed signals having pure sine wave (narrow band width), square wave (NRZ logic) and discrete pulse (RZ logic) shapes. This will enable improvements in a wide range of secure communications, radar, and surveillance functions in the military and improve signal quality possible from arrayed processors and low radiated power rf systems. Define a quantitative ranking scale for amplifier specifications that makes explicit how signal shape impacts the relative importance of phase and amplitude noise, peak gain and gain uniformity, dispersion, intermodulation, power consumption, and operating temperature. The goal is to define the best small signal amplifier technology for the three leading candidate technologies for high speed digital systems: superconducting JJ, InP HBT, and optoelectronics and each signal shape.

DESCRIPTION: In both optoelectronic and electronic receivers, low noise amplifiers are needed at the input to the electrical processor. Photodiodes have demonstrated bandwidths over 40 GHz while small circuits have internally clocked at 68 and 770 GHz in HBT and JJ. Superconducting digital electronics needs amplification of the signals before they are passed to room-temperature semiconductor based circuits due to their inherent RZ, 2 mV-ps pulse area. Today, this involves amplification of pulses with amplitudes of 200-300 uV to a few hundred mV clocked at 5-20 GHz, sometimes by conversion to NRZ waveforms. Purely digital free space signal transmission is increasingly attractive given the precedence of fiber optic communication. For this application, an amplifier capable of handling a 40-100 GHz square wave input signal with 5 ps rise/fall times, is needed as drivers of microwave power amplifiers. Both electrical and optical interfaces have been demonstrated for data rates up to a few Gbit/s without any WDM. The work should focus on higher data rates (10-20 Gbit/s) while minimizing power consumption and simplifying packaging. Approaches that demonstrate extendibility to data rates of 40-50 Gbit/s are preferred. This amplifier technology should not be application specific but may vary with pulse shape and initial amplitude. The amplification scheme may consist of one or more amplifier stages, including on-chip superconducting amplifiers and external semiconductor amplifiers, operating at different temperatures between 4 K and 400 K. Determination of amplification factors, noise figures, power consumption, and demonstrations that thermal modeling predicts the operating temperatures of different amplifier stages, is an important aspect of this research. Natural compatibility among technologies should be emphasized. Utilization of COTS components is preferred.

PHASE I: Evaluate the amplification requirements for a variety of applications with different signal shapes and input amplitudes. Design amplification schemes that are suitable for at least two of the applications listed. Experimentally verify at least one of these amplification schemes and characterize it in terms of gain, bandwidth, power consumption, and noise.

PHASE II: Build and demonstrate a multi-channel, low-noise amplifier technology suitable for high data rate digital links, and low amplitude electrical input signals. The demonstration must include integration with at least one of the applications for which the technology is deemed suitable.

PHASE III: Produce a self-contained prototype of a system containing the demonstrated amplifier technology for the chosen application.

COMMERCIAL POTENTIAL: This research will lead to the development of a range of multi-channel, low-noise, broadband, microwave amplifier products, including driver stages for power amplifiers, RF buffer amplifiers, low-noise receiver amplifiers. This amplifier technology will also enable the realization of the high-performance superconducting electronics technology, which has a number of promising applications in the scientific instrumentation and communications equipment. Markets including ADC/DAC components, transient digitizers, digital signal processors, true-time delay, correlators, fast memory and processors.

KEYWORDS: Broadband amplifier, optoelectronics, digital superconductivity, hybrid technology, cryogenic electronics, low noise amplifier

N00-T002

TITLE: Wide Bandgap Semiconductor Limiters

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: This work seeks to exploit recent advances in wide bandgap semiconductor (WBS) materials to develop high power, high speed PIN microwave limiters.

DESCRIPTION: As a result of their high breakdown field (~ 3 MV/cm) and high carrier saturation velocity (~2.0x10⁷ cm/s), the WBS (namely SiC and GaN) are ideal candidate materials for the realization of high power, high-speed microwave limiters and switches. SiC has the added advantage of a high thermal conductivity (up to 4.9 W/cm K, GaN has a thermal conductivity of ~2

W/cm K) while GaN has the benefit of heterostructures with AlGaIn to tailor the band structure. These properties imply that SiC or GaN based PIN diodes can outperform conventional parts in insertion loss, power dissipation, and recovery time.

While PIN diodes have been studied in SiC and GaN for low frequency rectifiers and uv-detectors, little work have been done on their use as microwave devices [1]. Key issues include obtaining the required low background doping of the intrinsic region and realizing low resistance p-ohmic contacts. In addition, further understanding is needed of the fundamental (and defect assisted) breakdown in these materials to insure the realization of avalanche breakdown.

PHASE I: The contractor shall develop the process technology, device design, and device model for high power, high speed WBS microwave limiters for operation at 7-11 GHz. Design considerations shall include power dissipation level, recovery time, and insertion loss. It is highly desirable that a reliable, low specific contact resistance ($<1 \times 10^{-6}$ $\Omega\text{-cm}^2$) p-type contact be demonstrated to p+-material. A positive temperature coefficient of breakdown shall be achieved to support the existence of available breakdown in the device. Initial microwave power dissipation testing should be realized.

PHASE II: The contractor shall develop and demonstrate a WBG PIN limiter able to dissipate an average power of >50 W (>2000 W peak, 10 microsecond pulse) of microwave power at 7-11 GHz with an insertion loss <1.0 dB. A full characterization of diode insertion loss, survivability, and recovery shall be performed.

PHASE III: The contractor should be able to compete for the supply of high power, high speed limiters for microwave receivers such as for radar and electronic warfare.

COMMERCIAL POTENTIAL: This work is expected to engender faster, more robust, lower loss microwave limiters for microwave communications and satellite links.

REFERENCES: See for example: IEEE Transaction on Electron Devices, Special Issue on SiC Electronic Devices, vol 46, March 1999.

KEYWORDS: microwave: microwave limiters, wide bandgap, silicon carbide, gallium nitride

N00-T003

TITLE: Wide Band Optoelectronic Field Effect Transistors

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: To develop solar blind GaN-based Optoelectronic Field Effect Transistors (OFETs) and Integrated Circuits for high-gain photodetectors.

DESCRIPTION: Visible-blind photodetectors are needed for the flame detection and for the detection of missiles and jet engines. The GaN-based OFETs will exhibit high-gain and are expected to be superior to two-terminal devices and suitable for integration with high-speed, high temperature wide-band gap semiconductor electronics.

PHASE I: Modeling and fabrication of prototype GaN-based Optoelectronic FETs and regular FETs. Assessment of technology and design of integrated circuits

PHASE II: Development of highly sensitive GaN-based OFETs and integrated circuits

PHASE III: Development of subsystems and systems for flame detection and for the detection of missiles and jet engines.

COMMERCIAL POTENTIAL: Flame detection is very important for power plants, gas turbine installations, and large-scale metal and semiconductor production facilities. These detectors will allow power industry to replace expensive and bulky systems by cheap and reliable GaN-based OFET detectors.

REFERENCES:

1. M. S. Shur and M. Asif Khan, GaN/AlGaIn Heterostructure Devices: Photodetectors and Field Effect Transistors, MRS Bulletin, Vol. 22, No. 2, pp. 44-50, Feb. (1997)
2. M. S. Shur and M. Asif Khan, GaN and AlGaIn Devices: Field Effect Transistors and Photodetectors, Gordon and Breach Science Publishers, Series Optoelectronic Properties of Semiconductors and Superlattices, Vol. 7 GaN and Related Materials II, pp. 47-86, S. Pearton, Editor (1999)

KEYWORDS: GaN, photodetector, visible-blind, Optoelectronic FET, missile detection, flame detection

N00-T004

TITLE: High Dynamic Range Digital Waveform Synthesizer and Beam Forming

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: To exploit the digital transceiver array and beam forming accuracy by means of analog-to-digital and vice versa conversion for arbitrary wide-band waveform at tens G Hz RF.

DESCRIPTION: Digital Array Radar (DAR) uses fully digitized T/R modules in a novel antenna array architecture. Advanced techniques and recent developments, (e.g. direct digital sampling, high rate, high dynamic range A/D converters, high-speed digital computation and digital fiber-optic interfaces) are employed. These technologies, leveraged from the commercial telecommunications, computers, and networking markets, combine to provide several orders of magnitude improvement in Navy radar system performance and promise low risk/cost for near-term acquisitions. One of the main risk areas is the accuracy of digital transceiver of arbitrary waveform, bandwidth at tens G Hz & beyond.

PHASE I: Develop techniques for the design and analysis of all digital transceiver A/D converters and beam forming accuracy at tens G Hz frequency and high bandwidth waveforms.

PHASE II: Apply the results and techniques developed in Phase I to the design and analysis of prototype for digital array A/D & D/A beam forming test bed.

PHASE III Transition roadmap is confirmed as the Technology Innovation Transition in PMO 02 NAVSEA PEO Theater Air Defense and Surface Combatants. In case of L-band it will be used for Volume Search Radar for DD21. When the radiating front is in case of S-band, or C-band, DAR will be useful for AEGIS SPY-II upgrade, etc. digital military radar cheaper and more accurate at higher bandwidths and frequencies.

DUAL USE APPLICATIONS: Successful commercialization of this technology will impact digital telecommunication in the frequency band of digital cellular phones, digital TV, digital satellite linkage, being matured in return will make the digital weather radar more powerful to detect the low resolution tornado core in mid-west region.

REFERENCES:

1. S. Norsworthy, R. Schreier, G. Temes, "Delta-Sigma Data Converters," IEEE Press , 1997
2. Digital Cellular Phones, e.g. Nokia and other name brand
3. Digital CD ROM,
4. Digital Car Antenna
5. Digital HD TV
6. Digital Satellite Transmission
7. Digital Video Transmission from UAV

KEYWORDS: Dynamic Range, Sigma-Delta ADC & DAC, Direct Digital Synthesizer, Digital Array Radar, Beam Forming

N00-T005

TITLE: Embedded Wireless Communications Capability

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Investigate technologies for communication badges.

DESCRIPTION: Today's sailors use two types of wireless handsets to meet their communication needs--one handset for netted talk groups using a push-to-talk similar to walkie-talkies and another handset for dial telephone service similar to a cellular telephone. Although technology combining these services in one handset is becoming available, the Navy cannot afford to equip every sailor on a ship with these expensive handsets. The cost and inconvenience of battery management associated with these handsets remains an additional burden. Embedding wireless communications technology in low cost multifunction Smart Cards offer an attractive alternative to these traditional wireless handsets so that every sailor would be issued a communication badge. These communication badges could be designed to provide touch activation, voice activated dialing, geolocation, health status monitoring, submersible to 10 meters, and support external devices including headset, barcode reader, imaging devices and radiation monitors. Cost effective methods for producing communication badges needs to be investigated. Ultrawideband and conventional narrowband approaches are encouraged.

PHASE I: Investigate the scientific, technical, and commercial merit and feasibility of producing Smart Card communication badges.

PHASE II: Build, test, and optimize a prototype system using shipboard wireless communication badges.

PHASE III: Once a prototype communication badge system has been shown to meet Measures of Effectiveness and Measures of Performance the technology can be transitioned in one of several ways. It can be developed as a commercial product for use in industrial and business applications, it can be marketed as an aftermarket enhancement to the wireless provider's system, or it can be incorporated as part of a larger shipboard program such as the aircraft carrier program office's Integrated Communications and Advanced Networks (ICAN) effort or DoD Smart Card programs.

COMMERCIAL POTENTIAL: The private-sector application of low cost communication badges developed under this STTR is applicable to industrial and business applications.

REFERENCES:

1. ISO 7810: 1995, "Identification Cards – Physical Characteristics."
2. CAPT James Hoffman, "Wireless and the Navy", Presentation to the Federal Wireless Working Group, Charleston, SC, May 11, 1999.
3. W. Rankl & W. Effing, SMART Card Handbook, John Wiley & Sons, New York, 1997.
4. T. S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall PTR, Upper Saddle River, New Jersey, 1996.
5. H. J. De Los Santos, Introduction to Microelectromechanical (MEM) Microwave Systems, Artech House, Boston MA, 1999.
6. Ultrawideband Working Group Web Page, <http://www.uwb.org>.

KEYWORDS: Smart Card, Shipboard, Wireless, Communications, Low Cost, ID Card

N00-T006

TITLE: Nitride Semiconductor Substrates

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: The objective will be to identify and develop/transfer the most promising technology for the growth of large diameter nitride semiconductor boules for substrates for AMRFS power MMICs, Solar Blind UV sensing, and Blue lasers etc.

DESCRIPTION: Extremely high power solid state devices under investigation at present use SiC substrates because of the high thermal conductivity. However if GaN substrates could be made with large area, device technology would be far simpler, and more affordable, by avoiding hetero-junctions between GaN and sapphire, or SiC.

PHASE I: Candidate growth techniques will be critically examined and tested. The process most likely to succeed will be identified for phase II down select.

PHASE II: A prototype technology will be developed for pilot production and sample distribution or film growth.

PHASE III: Extremely high power wide band amplifiers on GaN substrates will be available for testing.

COMMERCIAL POTENTIAL: Blue laser development will be massively accelerated, and microwave/millimeter wave amplifiers will be very strong commercial items.

REFERENCES:

1. Abstracts from ONR workshop on Bulk Nitride Semiconductors to be held NRL Nov 23/24 (1999)
2. Proceeding of the Int. Conf. on Nitride Semiconductors – Montpellier France (1999)
3. Gallium Nitride and related Semiconductors. EMIS data reviews, INSPEC/IEE (1999) Ed. J. Edgar, et al.

KEYWORDS: Semiconductor, group 3 nitrides, substrates, boule growth

N00-T007

TITLE: On Chip Delivery of Cooling Power at Cryogenic Temperatures

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Development of high efficiency cooling systems with low parasitic noise for removal of heat from the surfaces of cryogenically cooled electronics and sensors.

DESCRIPTION: Cryogenic cooling has become a widely adopted technique to improve the performance of electronics and sensors. RF receiver front-ends and DDS, infrared (IR) imagers, and ultra-sensitive magnetic signature sensors are some of the devices that exhibit improved performance when cooled in their space, military, and commercial applications. Sensor sensitivity in general depends on reducing the background noise due to thermal fluctuations and stabilizing the device's temperature dependent calibration. The power consumed by digital devices can be lowered when signal amplitudes are reduced as is possible when the thermal noise is also reduced by operation at sub-room temperatures. Active localized cooling can be used to prevent thermal run-away in high-density processor chips. Processing speed is increased by decreased resistance. Some high performance technologies such as superconductivity are available only at cryogenic temperatures. Adoption of any performance enhancing application of cryogenics is enabled by a cooling system that is totally transparent to the user – fully self-enclosed, energy efficient, serviced infrequently or never, and delivering cooling exactly where it is needed. It also must be a small fraction of the system cost, which is possible only if most of the parts are standardized. Moreover, since temporal variations in temperature may result in a degraded signal, it is desirable to keep such fluctuations below 10⁻³ Kelvin at 77K. Heat pipes, thermoelectric coolers,

high-conductivity flexible thermal links, and cryogenic refrigerants pumped through micro-pipes integrated into the substrate/MCM are some of the technologies of interest. Heat removal efficiency per unit electrical power expended; thermal fluctuations and hydrodynamic and electromagnetic noise at the device to be cooled; manufacturability, cost estimate, and prospects for ability to standardize cryocooler required for a wide variety of devices are the primary technical evaluation criteria to be used in evaluating proposals.

PHASE I: Demonstrate experimentally the technical feasibility of proposed cooling technique for simultaneously providing a 77K base temperature at each of 2 sensors (of nature agreed to by ONR) separated by a cm or more. Develop an implementation strategy showing feasibility of manufacturing; adaptability to a variety of configurations of devices needing cooling; analysis of issues to successful deployment on moving, vibrating, and rolling platforms; power requirements; maintenance, and cost.

PHASE II: Design, fabricate, and test of a technology demonstration unit (TDU) containing all the parts needed in a fielded system and cooling at least 2 separated devices. Demonstrate performance characteristics of the system under various operating conditions and environmental factors. Measure or develop calibrated method to quantitatively predict the effects of variable gravitational force or platform orientation in an unshielded environment and EMI and thermal fluctuation in the vicinity of the devices arising from the cooling system. Develop a commercialization-transition to Phase III plan, including description of strategy for developing a commercially viable technology.

PHASE III: Transfer the technology into a commercial application as well as an appropriate military application.

COMMERCIAL POTENTIAL: Cryocoolers are a critical enabling technology, especially for superconducting devices arrayed far apart. The phase II product would be sufficiently advanced to allow the technology's evaluation for integration into any application around 77K, including the cooling of high performance semiconductor chips, multi-channel wireless communications systems, and imaging SQUIDS used in medical research and non-destructive evaluation.

REFERENCES: T. Clem, "Superconducting magnetic sensors operating from a moving platform," IEEE Trans. Appl. Sup., vol. 5(2), p. 2124, 1995.

KEYWORDS: distributed cooling, electro-hydrodynamical cooling, thermoelectric cooling, cryocoolers, heat pipes, cryogenics

N00-T008

TITLE: Uncooled Infrared Photon Detectors

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop uncooled infrared photon detectors with high sensitivity and resolution in the mid and long wavelength range.

DESCRIPTION: Infrared photon detectors in the mid and long wavelength spectral region (3-12 μ m) have applications in numerous defense, medical and industrial systems such as night vision, reconnaissance, guidance, ranging, thermal imaging, thermography, meteorological research and free-space communication systems. Currently, numerous approaches are being followed, including intrinsic detectors based on HgCdTe, InSb, InAsSb, InTlSb, InSbBi, and quantum well detectors based on GaAs/AlGaAs, InGaAsP/InP (QWIP) structures, type II InSb/InAsSb and InAs/GaInSb heterostructures. In most applications, this current technology makes use of cryogenic coolers which are ill-suited because of their short lifetime, added power consumption, weight, volume and cost. Uncooled detectors have generally been difficult to achieve due to fundamental problems such as fast Auger recombination and fast LO phonon scattering. Nevertheless, room temperature operation has been promisingly demonstrated for InAsSb, InSbBi, and type II InAs/GaInSb superlattice detectors in the 3-12 μ m spectral range. The purpose of this effort is therefore to investigate and produce high sensitivity and high-resolution infrared detectors operating at room temperature in the 3-12 μ m range.

PHASE I: Demonstrate the fundamental technologies necessary to produce high sensitivity and resolution infrared photon detectors operating at room temperature. Design and test optimum device structure.

PHASE II: Produce, package and demonstrate operational, high sensitivity and resolution infrared photon detectors.

PHASE III: Develop reliable infrared photodetector product operating at room temperature applicable for integration in night vision, reconnaissance, guidance, ranging, thermal imaging, thermography, communications, etc.

COMMERCIAL POTENTIAL: Potential defense-related applications for infrared photon detectors include enemy target detection, proximity fuze, smart bombs, LIDARs, active infrared countermeasure systems against missile threats, night vision in the battlefield, non-metallic land mine detection. These detectors will also be useful in medical applications such as thermal imaging for diagnosis of breast cancer, dental and thyroid diseases, non-invasive measurement of the oxygen level in organs during surgery, and blood sugar monitoring. Infrared detectors can also be used in industry in non-destructive testing and inspection techniques, for the fast detection of hidden cracks and non-uniformity, for the monitoring of chemical quality and process control, remote sensing and for free space communication.

REFERENCES: M. Razeghi, "Roadmap of semiconductor infrared lasers and detectors for the 21st century," in Photodetectors: Materials and Devices IV, ed. G.J. Brown and M. Razeghi, SPIE Proceedings Series, vol. 3629 (Bellingham, Wash.: SPIE-The International Society for Optical Engineering, 1999), 2-40.

KEY WORDS: IR detectors, uncooled detectors, sensors, countermeasure, night vision, thermal imaging

AIR FORCE PROPOSAL PREPARATION INSTRUCTIONS

The responsibility for the implementation and management of the Air Force STTR Program is with the Air Force Research Lab, Wright-Patterson Air Force Base, Ohio. The Air Force STTR Program Manager is Steve Guilfoos, (800)222-0336. **DO NOT** submit STTR proposals to the AF STTR Program Executive under any circumstances. Addresses for proposal submission and numbers for administrative and contracting questions are listed on the following page

Technical questions may be requested using the DTIC SBIR Interactive Technical Information System (SITIS). For a full description of this system and other technical information assistance available from DTIC, please refer to section 1.5c of this solicitation.

The Pre-Solicitation Announcement (PSA), listing the full descriptions of the topics and the author of each, was issued electronically and in hard copy, after being announced in the Commerce Business Daily. Contact the AFOSR directly for information on future PSAs (see mailing address and phone number on the next page). Open discussions can be held with topic authors until 1 Mar 00 concerning technical aspects of topics. Small businesses that did not know about the PSA or did not participate in the exchange may find relevant questions or comments from these talks listed in SITIS, please refer to section 1.5c of the solicitation.

For each Phase I proposal, send one original and three (3) copies to the office designated on the following page. Be advised that any overnight delivery may not reach the appropriate desk within one day.

Unless otherwise stated in the topic, Phase I will show the concept feasibility and Phase II will produce a prototype or at least show a proof-of-principle.

Air Force Fast Track

Detailed instructions on the Air Force Fast Track and Phase II proposals, consistent with this solicitation (see Sec. 4.3 and 4.5), will be given out by the awarding Air Force directorate along with the Phase I contracts.

PROPOSAL SUBMISSION INSTRUCTIONS

<u>TOPIC NUMBER</u>	<u>ACTIVITY/MAILING ADDRESS</u>	<u>CONTRACTING AUTHORITY</u>
	(Name and number for mailing proposals and for administrative questions)	(For contract questions only)
AF00T002 thru AF00T010 AF00T012 thru AF00T020	Air Force Office of Scientific Research AFOSR/NI 4040 N. Fairfax Dr., Ste 500 Arlington VA 22203-1613 (Victoria Franques, (703)696-7313)	Anne Carroll (703) 696-5983

AIR FORCE FY2000 STTR TOPICS

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH, ARLINGTON VA

AF00T002	In Situ Evaluation of Composite Structural Performance in Presense of High Stress/Strain Gradients
AF00T003	Criteria Management System for Multi-Objective Optimization Guided Design of Sequences of Materials Processes
AF00T004	Next Generation, Polymeric-based Nanostructured Materials
AF00T005	Micro-Discharge Devices and Applications
AF00T006	High Frequency Vortex Generation for Active Flow Control
AF00T007	Controller Synthesis for Micro Electro-mechanical Systems (MEMS) Aerodynamic Sensor/Actuator Arrays
AF00T008	Chemical Propulsion for Microsatellites
AF00T009	Coated High Temperature Superconductors (HTS) for Power Systems
AF00T010	Processing of Affordable Advanced Ceramics for Hyper-Temperature Applications
AF00T012	Implementation of Biomimetic Precison Flight in Autonomous Air Vehicles
AF00T013	Heat Reduction in Semiconductors
AF00T014	High Frequency Optical Wavefront Sensors
AF00T015	Automated Location of Structured Expertise in Very Large and Dynamic Information Repositories
AF00T016	Space Ready Polymeric Materials
AF00T017	Terahertz Devices
AF00T018	Pulsed Detonation Propulsion Alternative for Space
AF00T019	Computational Tools for the Sensitivity Analysis and Control of Combustion Instabilities
AF00T020	High-Average-Power, Highly-Efficient, Visible-Wavelength, Solid-State Laser Sources

AIR FORCE FY2000 STTR TOPICS DESCRIPTIONS

AF00T002 TITLE: In Situ Evaluation of Composite Structural Performance in Presence of High Stress/Strain Gradients

TECHNOLOGY AREAS: Materials/Processes, Human Systems

OBJECTIVE: To demonstrate a novel in situ strain measurement techniques for measuring strains in localized regions of textile composites and composite structural joints.

DESCRIPTION: Textile composite preforms are extensively used in many structural components of complex shapes and for low cost processing. Due to complex weaving pattern of the preforms, the deformation behavior and hence the strain field in constituent preform yarns that causes the failure initiation needs to be accurately determined. Surface mount strain gages often fail to capture the critical strain field causing failure. The use of fiber optic strain gages to measure in situ strains within textile reinforcements (both impregnated and unimpregnated) potentially will provide strain field at the unit cell level. The measurement of strain field within the reinforcement will provide an accurate means of validating failure models. Further, these fiber optic strain gages also provides a means to determine strain field in composite joints (bolted and bonded joints) near material discontinuity. This novel strain measurement technique would provide new and unique data by which material models can be validated and (perhaps) the effect of damage on stress/strain fields can accurately be assessed for textile composites and composite joints.

PHASE I: Demonstrate processing of fiber optic sensors within reinforcement of woven composites. The processing is to include weaving of the sensors into the reinforcement for different weaving architectures, such as, plain weave, 5HS, 8HS fabrics. Develop appropriate data reduction techniques for reducing fiber optic data to strain field.

PHASE II: Validate the strain measurement technique with a predictive model for measuring in situ strains for textile preforms and its composites. Textile preforms are to include woven and braided reinforcement architectures, both balanced and unbalanced reinforcements. Demonstrate the capability of the strain measurement for measuring strains in embedded reinforcement at high strain gradients of bolted and/or bonded joints.

PHASE III DUAL USE COMMERCIALIZATION: Fabric and textile preforms, in addition to Air Force's systems, are extensively used in many commercial structures for low cost processing. A prime example is the containment ring for turbine engines. A successful implementation of this in situ measurement technique will validate failure theories, and thus textile composites will be applied in many commercial and military primary structures and efficient composite joints will be designed with increased confidence.

REFERENCES:

1. A. Skontorp, Effect of Embedded Optical fibers on Structural Integrity of Composites, Proc. of ICCM-12, Paris, July 4-9, 1999
2. A. K. Roy, In Situ Damage Observation and Failure in Model Laminates Containing Planar Yarn Crimping of Woven Composites, Mechanics of Composite Materials and Structures, Vol. 3, No. 2, 1996, pp. 101-117.
3. A. K. Roy, Three-Dimensional Mixed Variational Micromechanics Model for Textile Composites, Proceedings of the 39th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Long Beach, CA, April 20-23, 1998.

KEYWORDS: Composite, Structural Performance, High Stress/Strain Gradients

AF00T003 TITLE: Criteria Management System for Multi-Objective Optimization Guided Design of Sequences of Materials Processes

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop visual and computational techniques that can be used in coordination with mathematical design optimization algorithms and process simulation methods to assist in the judicious management of objectives and constraints during the design of sequences of manufacturing processes.

DESCRIPTION: In order to more effectively address affordability requirements of Air Force systems, especially in the areas of materials processing and manufacturing, consideration of the entire production sequence during all design phases, rather than just one process at a time, is required. Because of the number of decision variables, nonlinear dynamical nature of materials processes, and complex interactions among the processes in a sequence, the only practical way to achieve near optimal designs is to use mathematical optimization techniques combined with coupled, computer simulations of the processes. While significant progress has been made in recent years in the analytical development of simulation tools and optimization algorithms, little or no effort has been invested in trying to address the primary obstacle to using such systems in an industrial environment: the ability to effectively communicate to the user/designer the relationship among the various objectives and constraints (such as cost, timing, product quality) and the impact of potential tradeoffs among these design criteria, i.e., the ability to manage the design criteria in a formal optimization environment. The lack of this ability leads designers to perform their own non-optimal tradeoff studies by varying the decision variables using intuition ("twiddling") rather than performing optimal tradeoff studies by varying design criteria or studying algorithm-generated design

alternatives ("thinking"). By making simulation-based, optimization-guided design standard industrial practice rather than an academic exercise, significant reductions in cost can be achieved by using the optimal tradeoff studies that can be achieved early in the system acquisition when most of the cost is committed.

There are three overall project objectives. The first is the development of computational and visual techniques for presenting information concerning the relationships among large numbers of decision variables and design criteria to designers and for determining the impact of changing either the variables or the criteria. Second is the creation of a comprehensive software framework for integrating these new design tools with existing mathematical optimization algorithms and process simulation techniques. Last is the demonstration of the effectiveness of this framework through application to process design problems relevant to the Air Force: e.g., forging, casting, heat treatment, coating processes, etc.

Specific performance objectives of the proposed effort are:

PHASE I: 1) Using existing state-of-the-art optimization algorithms and appropriate materials and process simulation tools as a basis, develop prototype computational and visual techniques for communicating the complex relations among numerous (greater than 3) design objectives, constraints, and decision variables to designers. 2) Demonstrate the effectiveness of the prototype approach through application to a process design problem of limited complexity.

PHASE II: Based upon the assessed level of effectiveness of the techniques developed 1) improve the techniques through interaction with important Air Force parts and systems suppliers; 2) develop a comprehensive, extensible software framework for integration of optimization techniques, process modeling and simulation tools, and high dimensional visualization techniques; and 3) demonstrate effectiveness through application to a design problem of moderate to high complexity.

COMMERCIAL POTENTIAL: Commercial application is very broad, including DoD OEM's and their suppliers as well as the automotive industry. Application areas include the processing of bulk materials (forging, extrusion, etc.) and thin-film coating processes (pulsed-laser-deposition, chemical-vapor-deposition, etc.), and processes common to both areas such as heat treatments.

REFERENCES:

1. Fiacco, A.V., Introduction to Sensitivity and Stability Analysis in Nonlinear Programming, Academic Press, 1983
2. Greenberg, H.J., "An Annotated Bibliography for Post-solution Analysis in Mixed Integer Programming and Combinatorial Optimization," Advances in Computational and Stochastic Optimization, Logic Programming, and Heuristic Search, D.L. Woodruff (ed.), Kluwer Academic Publishers, Boston, 1998, p. 97-148
3. Miettinen, Kaisa, Nonlinear Multiobjective Optimization, Kluwer Academic Publishers, Boston, 1999
4. Mistree, Farrokh & H.M. Karandikar, "Conditional Post-solution Analysis of Multi-objective Compromise Decision Support Problems," Engineering Optimization, Vol. 12, 1987, p. 43-61

AF00T004

TITLE: Next Generation, Polymeric-based Nanostructured Materials

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop fabrication and processing technologies for polymeric-inorganic nanostructured materials

DESCRIPTION: Commercial and academic interest in nanostructured materials is rapidly growing¹. In these materials, the fundamental length scale of the morphology approaches the critical length scale of various physical phenomena, leading to physical and chemical behavior dramatically different from that observed in their bulk and microscale counterparts. In addition, properties associated with the interface between constituents become prominent as the total interfacial area increases with finer phase dimensions. These factors afford the opportunity to combine physical properties and create multifunctional materials not possible with conventional composites and filled systems comprised of microscale constituents. Nanostructured materials, in which polymers are a major constituent, are especially exciting because of the potential to exploit the inherent processing advantages and low-cost economics of polymers. Some examples of recent inorganic-polymeric nanostructured blends included polymer-layered silicates nanocomposites, Polyhedral Oligomeric Silsesquioxane (POSS) containing polymer blends, high-performance conducting fibers, photorefractive hybrids, carbon nanotube blends and nanoparticulate blends. The polymer layered silicate nanocomposites² are an excellent example in which the addition of less than 4 vol% of dispersed, high aspect ratio inorganic sheets results in the enhancement of large number of physical properties, including mechanical (modulus, strength, thermal expansion coefficient), barrier, flammability resistance, ablation performance, environmental stability, and solvent uptake.

Performance, cost and weight constraints associated with future Air Force space and aerospace operations necessitate the development of new material with unique and tailorable properties that can enable a single component to perform diverse functions. Polymeric-based nanostructured materials are emerging as a family of materials to enable this 'multifunctionality.' New, economically viable fabrication and processing techniques are sought which enable production of monolithic (50 microns or greater) shapes of new-types of polymeric-based nanostructured materials.

PHASE I: Development of a polymeric-inorganic nanostructured material system. Emphasis will be placed on inorganic-polymeric nanostructured materials, which combine superior mechanical properties (modulus and toughness relative to the neat resin), with enhanced barrier and chemical stability; enhanced electrical and thermal conductivity; and/or novel nonlinear optical properties.

PHASE II: Select the material systems with the most promising combination of physical properties, and further developed techniques necessary for the reproducible fabrication of commercially viable specimens in the form of films, fibers and molded components.

PHASE III DUAL USE COMMERCIALIZATION: Commercial applications would include structural components in automobiles, replacement of current filled polymer systems in automobiles, replacement of conventional fiber composites such as fiber glass, and packaging materials such as films and containers for foods which require low permeability and recyclability. Application in commercial and AF systems would include cryogenic storage tanks, low-observable systems and satellite communication

REFERENCES:

1. Global Assessment of R&D Status and Trends in Nanoparticles, Nanostructured Materials, and Nanodevices, International Technology Research Institute, Loyola College in Maryland, Baltimore, MD.
2. Modern Plastics, June 1999, 37.
3. R.A. Vaia, J-W Lee, C-S Wang, B. Click, G. Price, Chem. Mater., 1998, 10, 2030-2032.
4. Winiarz, J.G.; Zhang, L.; Lal M.; Friend, C.S.; Prasad, P.N. J. Am. Chem. Soc., 1999, 121, 5287.
5. Pileni, M.P. Langmuir, 1997, 13, 3266.

KEYWORDS: Polymeric-based Nanostructured Materials

AF00T005 TITLE: Micro-Discharge Devices and Applications

TECHNOLOGY AREAS: Electronics

OBJECTIVE: To explore and develop devices for applications of the recently discovered unusual light emitting properties of micro-discharges.

DESCRIPTION: Recently micro-fabrication techniques have been applied to producing micro-discharges based on miniaturized hollow cathodes. These novel discharge structures can operate in a regime of power deposition rate in discharge-excited gases that differs significantly from those pertaining to bulk discharges or larger hollow cathode discharges. Such structures could be of significant interest in making powerful and inexpensive lighting sources, or in creating plasma's for chemical production useful for bulk gas processing or trace chemical agent removal. They could be the basis of optical diagnostics that could be integrated with micro-electronic systems to incorporate optical systems in a "laboratory on a chip." The potential for inexpensive mass fabrication would make such a laboratory on a chip potentially suitable for incorporation in the monitoring and control of combustion systems. Arrays of micro-discharges could provide short wavelength pump radiation for short wavelength lasers, or could, potentially, be locked together to make lasers directly. This STTR effort seeks innovation in the application of micro-discharges in areas such of visible, UV, or IR light sources or lasers, optical diagnostics, inexpensive chemical or surface processing by deep UV radiation or plasma processes, or the integration of micro-discharge technology to make other useful sensors or systems.

PHASE I: Prove in the laboratory a key aspect of the concept for a significant application of micro-discharges. This initial effort should also define the needed steps for fabrication or materials needed for the micro-discharges, as well as examine the integration of the micro-discharge technology with other elements of the entire system.

PHASE II: Development of a laboratory prototype system that could be scaled or further integrated in the Phase III, non-STTR activity. Uses in military applications might include materials processing, plasma- or ultraviolet based remediation of contaminated air, paint removal, or chemical agent detection in point or mobile sensors.

PHASE III DUAL USE COMMERCIALIZATION: Civilian applications include sensors for industrial control and pollution systems, chemical processing and novel light sources.

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KEYWORDS: Micro-Discharge Devices/Applications

AF00T006

TITLE: High Frequency Vortex Generation for Active Flow Control

TECHNOLOGY AREAS: Air Platform, Space Platforms

OBJECTIVE: Develop high bandwidth mechanical devices for separation control on military air vehicles flying at transonic conditions.

DESCRIPTION: Within the last several years, great strides have been made in active flow control technology for both external and internal flow applications. The work of Wiltse and Glezer [1] on synthetic jets and McManus et al [2] on pulsed vortex generator jets are only two examples of work that has advanced the state-of-the-art in flow separation control. Because of these previous efforts and others, active flow control devices are now being seriously considered for flight validation testing and subsequent military and commercial aircraft fleet applications.

The ongoing research of Seifert and Pack [3] on oscillatory control of flow separation, however, indicates that more effective means of flow control may be at hand if a low cost, reliable oscillatory device can be configured and integrated into an aircraft lifting surface or curved inlet duct. Seifert demonstrated separation control on an airfoil model at Reynolds numbers as high as 13(10)6 and has shown that oscillatory blowing at reduced frequencies in the range of 0.5 to 1.0 is effective over a wide range of Reynolds numbers. If an affordable mechanical device can perform as well as the oscillatory blowing devices of the work described above, then these mechanical devices, being easier to integrate, might be transitioned to real flight vehicles.

PHASE I: Conceptual evaluation of various high frequency mechanical flow control concepts; comparison with oscillatory blowing concepts. Design and bench test "best" concept. Wind tunnel proof of concept test of the "best" concept.

PHASE II: Build a "design tool" for integrating high frequency mechanical flow control actuators for separation control on air vehicles. Large-scale test at transonic speeds.

PHASE III DUAL USE COMMERCIALIZATION: A high bandwidth mechanical actuator will have both the required frequency and displacement necessary for flow control on real systems at real flight conditions. Applications in commercial and AF systems would include: (1) control of flow oscillations in weapons, landing gear, and instrument bays, (2) control of flow separation on control surfaces in military and commercial aircraft, and (3) control of flow-induced noise in turbomachinery and automobiles.

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3. Seifert, A. and Pack, L.G., "Oscillatory Control of Separation at High Reynolds Numbers", AIAA-98-0214, Jan 1998.

KEYWORDS: High Frequency Vortex Generation, Active Flow Control

AF00T007

TITLE: Controller Synthesis for Micro Electro-mechanical Systems (MEMS) Aerodynamic Sensor/Actuator Arrays

TECHNOLOGY AREAS: Air Platform, Electronics

OBJECTIVE: Demonstrate the feasibility of synthesizing robust feedback controllers for aerodynamic flows using micro electro-mechanical systems (MEMS) sensor and actuator arrays.

DESCRIPTION: Concepts for using micro sensors and actuators to control flow over aerodynamic surfaces offer the potential of enhanced flight performance for both autonomous and manned air vehicles. Laboratory experiments have demonstrated that micro actuators can yield reduced drag, increased lift, and control of unsteady aerodynamics. These effects could result in extended range, increased flight endurance, reduced fuel consumption, increased control response, and enhanced maneuverability for the next generation of tactical munitions, unmanned air vehicles (UAVs), and manned aircraft. The purpose of this program is to mature new feedback controller synthesis approaches, fundamentally different from synthesis methods currently used for air vehicle flight control system design, which will be required to realize the full benefits of MEMS-based aerodynamic flow control.

The control theory literature abounds with papers on controller design for distributed parameter systems. Most of the techniques involve posing and solving optimal control problems for systems of partial differential equations, based on a variety of assumptions that may or may not be appropriate for this project. A significant portion of the early effort on this project should be directed toward an assessment of the merits and drawbacks of various approaches for producing MEMS-based active aerodynamic flow controllers. It is envisioned that these controllers will be implemented in circuitry that is integrated with the sensor/actuator arrays. Factors to consider include:

- > Controller robustness to uncertainties arising from unmodeled dynamics, disturbances, nonlinear actuator interactions, sensor noise, and data latency
- > Sensitivity to errors in measurement or estimation of system states or parameters

- > Distribution of sensors and actuators
- > Complexity of implementing the control scheme

Dynamics models for feedback controller synthesis must be developed from appropriate mathematical models of the local flow conditions, actuator dynamics, actuator interactions, and sensor characteristics. Analytical or empirical data may be used as the basis for these models. Since air vehicles are expected to operate over a range of flight conditions, the models must be valid for variations in velocity, pressure, temperature, and vehicle attitude.

Although the theory for designing controllers for distributed parameter systems is not fully mature, the rapid advances in MEMS technologies will soon make it possible to produce large arrays of micro actuators and sensors with integrated control circuitry. A significant goal of the project is to conduct a hardware demonstration of a candidate robust feedback controller on a prototype MEMS-based aerodynamic sensor/actuator array. Thus, availability of prototype sensor, actuator, and processing hardware, as well as appropriate test facilities, must be considered. In preparation for the hardware test, a preliminary evaluation of the candidate control approach in digital simulation, using models of appropriate fidelity to demonstrate the feasibility of the concept, should be conducted.

PHASE I: Assess the merits and drawbacks of various robust feedback controller synthesis approaches for a MEMS-based active aerodynamic controller. Conduct an evaluation of the most appropriate prototype controllers in digital simulations. Produce a test plan for conducting a Phase 2 aerodynamic flow control hardware demonstration implementing the chosen feedback control approach or approaches.

PHASE II: Refine, as needed, the aerodynamic flow control design concepts and simulations developed in Phase I. Prepare and conduct the feedback control hardware demonstration using a prototype MEMS-based aerodynamic sensor/actuator array. This hardware demonstration will consist of prototype sensor, actuator, and processing hardware in a suitable test facility. Performance and potential benefits of the use of the prototype array configuration will be assessed quantitatively during this hardware in the loop demonstration.

COMMERCIAL POTENTIAL: Successful demonstration of MEMS-based aerodynamic sensor/actuator arrays for flow control will lead to many military and commercial applications. Applications include tactical munitions as well as other aircraft. Reduced Lift/Drag ratios will improve cruise range of a variety of aircraft. Moreover, these arrays can be used to enable agile tactical missiles or fighter aircraft to perform extreme maneuvers under post-stall flight conditions. Use of these arrays to augment the performance of conventional aerodynamic surfaces will allow commercial or military transport aircraft to fly below current stall speed, enabling them to utilize shorter runways for takeoff and landing.

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3. Orlov Y. and Bentsman J., "Adaptive Distributed Parameter Systems Identification with Enforceable Identifiability Conditions and Reduced Order Spatial Differentiation", Proceedings of 37th IEEE CDC, Dec. 1998.
4. Padhi R. and Balakrishnan S.N., "Adaptive-Critic Based Optimal Control Design for Distributed Parameter Systems", submitted to 2000 American Control Conference, June 2000.

AF00T008

TITLE: Chemical Propulsion for Microsatellites

TECHNOLOGY AREAS: Space Platforms

OBJECTIVE: Investigate and develop chemical-propellant-based concepts that would provide high thrust and high velocity impulse maneuverability for microsatellites. The scope of the work includes the identification of high-performance propellants and the evaluation of relevant issues associated with using such propellants in micropropulsion systems.

DESCRIPTION: The Air Force envisions many missions that would benefit from small, low-cost satellites operating either autonomously or as an element in a cluster of such vehicles. For this purpose, microsatellites are defined as spacecraft having mass between 10 and 100kg. Whereas the continuing miniaturization of electronic components has provided for a sharp reduction in the payload mass necessary to perform a particular mission, the requisite micropropulsion systems have not yet been developed. Energy dense propellants are a requirement for microsatellites. to reduce the mass associated with propellant storage and to maximize their useful lifetimes, and advanced chemical propellants are sought for missions requiring high thrust and high velocity impulse. Various reduced-toxicity, high-energy-density (by comparison with N2H4 or MMH/N2O4) chemical mono- and bipropellants have advanced from the research laboratory to the developmental testing stage. However, it is becoming apparent that traditional catalyst, catalyst bed, combustion chamber, and exhaust nozzle materials cannot withstand the higher temperatures associated with more energetic propellants. Monopropellant formulations containing high concentrations of energetic salts, for example, can have decomposition temperatures in excess of 2500 K. In addition to the materials considerations, there are problems associated with propellant flow, mixing, and combustion in propulsion systems with small characteristic length and volume scales. Clearly, there is a need to design a micropropulsion system that addresses the issues associated with the combustion or decomposition of high-energy-density chemical propellants.

PHASE I: Identify the materials and other design and engineering difficulties associated with using high-energy-density chemical mono- or bipropellants in a micropropulsion system. Particular attention should be paid to materials that can withstand the higher combustion temperatures associated with energetic propellants. The preliminary design of a micropropulsion system is the expected deliverable of Phase I.

PHASE II: Construct and demonstrate a prototype of the micropropulsion system designed in Phase I. This would include test firings with high-energy-density chemical propellants to determine the viability of the design.

PHASE III DUAL USE COMMERCIALIZATION: Microsatellites, with micropropulsion being the enabling technology, are proposed for several military applications, and they would also be expected to have many commercial customers.

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KEYWORDS: Chemical Propulsion, Microsatellites

AF00T009

TITLE: Coated High Temperature Superconductors (HTS) for Power Systems

TECHNOLOGY AREAS: Materials/Processes, Electronics

OBJECTIVE: Understand and exploit relations between processing parameters and resulting mechanical, electrical and magnetic properties to produce an innovative coating technology that will yield uniformly high critical-current density over kilometer lengths while maintaining structural integrity and long-term stability in the range of liquid-nitrogen temperatures.

DESCRIPTION: Superconducting (HTS) generators and motors are expected to provide the most compact, efficient power delivery to air- and ground-based weapons systems currently being designed. As a result, AFRL's Directed Energy Weapons Directorate has declared superconductive materials as an enabling technology. The key to a successful coated HTS conductor technology is a thorough understanding and control of the entire coating process [1,2]. Phase 1 will involve an evaluation of existing coating technologies and of existing methodologies to characterize the quality of conducting tapes produced by existing processes. Beyond the evaluation process itself, preliminary conductor fabrication and characterization efforts should be launched to investigate directly how to advance the state of the art. Consideration should be given to both chemical and physical deposition methods for deposition of a buffer and of YBCO (the acknowledged best HTS material for generating optimum critical currents in a magnetic field environment). Additional considerations may include replacing a textured buffer layer with a high-conductivity normal metal, and how the entire coating process may be accomplished without degradation of the superconductive (YBCO) layer. This phase 1 effort (and phase 2 if it is awarded) should be coordinated with ongoing studies at Wright-Patterson AFB – contact Dr Paul Barnes (barnespn@possum.wpafb.af.mil).

PHASE I: Evaluate existing HTS coated conductor technologies and perform limited studies to develop one or more promising fabrication techniques to produce long lengths of rugged HTS coated conducting tapes with high critical-current density in relevant magnetic fields at or near liquid-nitrogen temperatures.

PHASE II: Perform controlled, small-sample fabrication studies to develop an optimum set of processing parameters for one or more fabrication technologies. Characterization tools are likely to include electron microscopy and magneto-optic imaging. When the most promising processing technology has been determined, scale up the length of coated conductor to at least one meter and check for uniformity over the entire length of specimens produced. Ensure that a process producing high-quality coated superconductive tape can be scaled to 1-km lengths of this quality, and fabricate a prototype tape at least 10 m long.

COMMERCIAL POTENTIAL: A successful coated HTS conductor technology would impact almost all Air Force and other DoD power generation, storage and conditioning systems. It would have an even greater impact on this nation's electrical utility industry and those manufacturing industries that depend most sensitively on reliable and stable electric power. Among the most important commercial applications are motors and generators, superconductive magnetic energy storage systems, high-power transformers, fault current limiters, uninterruptable power supplies and high-power transmission lines [3].

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3. "Power Quality, Superconducting Magnetic Energy Storage Systems, and Fault Current Limiters," M. Parizh and E. Leung in Applications of Superconductivity, H. Weinstock editor (Kluwer, Dordrecht 1999).

AF00T010

TITLE: Processing of Affordable Advanced Ceramics for Hyper-Temperature Applications

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: To develop novel approaches toward affordable processing of non-oxide ceramic structural materials for hyper-temperature applications, in the range of 2,000 to 3,000 C.

DESCRIPTION: This announcement seeks to advance the state-of-the-art of processing non-oxide ceramic materials for hyper-temperature applications, in the range of 2,000 to 3,000 C. In particular, it concentrates on novel, economical technologies for fabricating hafnium carbide (HfC), titanium carbide (TiC), titanium and zirconium di-borides (TiB₂, ZrB₂) and other ceramic materials capable of retaining good mechanical properties and exhibiting low ablation rates at the extreme temperatures. The critical research and development areas to be addressed are: (1) The role of additives on the oxidation resistance of refractory carbides and borides; (2) The effects of solid solutions and eutectic microstructures on strength; (3) The development of affordable processing and manufacturing technology to fabricate dense, near-net-shape ceramic components; (4) In situ characterization of the morphology of the materials during testing at elevated temperatures and using these data for life-prediction of the ceramic components; The advances in these technologies should lead to fabrication of affordable materials for the next-generation of rocket engines and hypersonic spacecraft capable of operating at temperatures in excess of 2000 C with vital Air Force and dual-use applications.

PHASE I: Develop the relationship between composition, microstructure, processing, properties, and performance (life-prediction) of a selected hyper-temperature material system. The selected system should be of major importance to the Air Force program on rocket propulsion or hypersonic air-spacecraft applications (this is one of the evaluation criteria). Optimize processing of the material system and provide measurements of strength, fracture toughness, creep resistance, and environmental stability for the selected system. The aim of the Phase I is to establish a sufficient database for estimating the economics of manufacturing parts from the selected material and the probability of success for introducing this material into Air Force applications

PHASE II: Phase II STTR efforts should take the developments of Phase I and design, develop, and manufacture a prototype. This prototype does not have to be up to the flight specifications level, but should clearly show the potential to meet mutually agreed operational specifications established by an Air Force contractor. Thus the Phase II has three deliverables, the prototype with appropriate characteristics, the established relationship with an Air Force supplier, and the demonstration of future potential improvements in reliability, affordability, performance, and other parameters important for the Air Force.

COMMERCIAL POTENTIAL: By developing an affordable hyper-temperature material system with temperature capabilities of 2000 – 3000 C, the necessity of engine cooling can be significantly reduced, resulting in cleaner burning rocket engine. Thus, fuel utilization can be vastly improved, more payload can be sent to space, higher specific impulse can be achieved and the cost of the rocket engine can be reduced with major impact on military and civilian space technologies.

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3. "Ablation Resistant Zirconium and Hafnium Ceramics", US Patent # 5,750,450

AF00T012

TITLE: Implementation of Biomimetic Precision Flight in Autonomous Air Vehicles

TECHNOLOGY AREAS: Air Platform, Space Platforms

OBJECTIVE: Demonstrate the use or incorporation of insect neurobiology or sensory processing into the design of precision flight capability of autonomous air vehicles.

DESCRIPTION: The purpose of this project is to develop and demonstrate guidance, navigation, and control (GNC) sensors, components, and/or systems that will enable an autonomous small air vehicle to search for, detect, pursue, and rendezvous with an evasive target in a densely cluttered environment. Success of this endeavor would enable meaningful application payoff in autonomous munitions as well as miniature / small autonomous reconnaissance aircraft. There are both military and civilian (e.g., search and rescue) applications for this capability. The technology required to enable these autonomous precision flight capabilities are based in GNC systems that exploit an extreme complexity and functional interdependency of sensors, processing, flight control, and propulsion; current GNC system design methods are inadequate for the task. For this reason, flying insect neurobiology (e.g., insects in the orders Odonata, Diptera, or Coleoptera) are inspirational for successful designs and configurations of these GNC systems.

The literature on flying insect neurobiology abounds with papers describing the ways insects process information from various sensors to achieve precise navigation and flight. Insects integrate information from inertial sensors (halteres in Diptera, the connection between the thorax and large head of Odonata), air flow sensors (small hairs on the body and head, and Johnston's organ on

antennae), internal strain sensors (campaniform sensilla at the base of wings and halteres), and position sensors between adjacent body parts (proprioceptors) with information from the compound eyes (e.g., imaging, optic flow) and ocelli (light intensity) for precision navigation and flight through complex environments. A significant portion of the early part of this project should be devoted to identifying models from insect neurobiology that are suitable bases for GNC system design. With inspiration from these models, a GNC system design is to be developed for a suitable air vehicle prototype. Desirable characteristics of the GNC system include:

1. tolerant to transient sensor information distortion or obscuration,
2. capable of obstacle avoidance (e.g., buildings or trees, power lines or overhanging branches),
3. detection, acquisition, tracking, and guidance to a moving target in background clutter,
4. precision rendezvous with the target (e.g., warhead event, electronic tagging) flight control robustness to wind gusts, turbulence near structures, and
5. complexity of implementing the GNC scheme.

Rapid advances in micro sensor, micro actuator, and processing technologies will soon make it possible to produce small air vehicles that are physically capable of precision flight. The design of GNC systems to exploit the potential capabilities of this hardware is critical to realizing precision flight autonomously. Although the knowledge base of insect neurobiology is quite large, insect biomimetics, especially as applied to aerospace operations, is a relatively immature field. GNC system designs based on insect biomimetics have yet to be demonstrated. Thus, a significant goal of the project is to conduct a demonstration of a candidate GNC system in a prototype sensor hardware-in-the-loop test. For this reason, availability of prototype sensor, actuator, and processing hardware, as well as appropriate test facilities, must be considered. In preparation for the hardware test, a preliminary evaluation of the candidate control approach in digital simulation, using models of appropriate fidelity to demonstrate the feasibility of the concept, should be conducted.

PHASE I: From suitable insect neurobiology candidate models, demonstrate that a GNC system for autonomous precision flight is feasible from a biomimetics standpoint. Conduct an evaluation of a prototype biomimetic-GNC system in a digital simulation. Develop a test plan for conducting a Phase II sensor hardware-in-the-loop demonstration.

PHASE II: Refine the biomimetic-GNC system design tested in Phase I for more extensive sensor hardware-in-the-loop testing. Further demonstrate the feasibility of this approach. Prepare and conduct a demonstration using prototype sensor hardware in a suitable hardware-in-the-loop facility.

COMMERCIAL POTENTIAL: Air vehicles capable of autonomous precision flight would have several commercial and military customers. Applications would include small surveillance and reconnaissance aircraft as well as AF unmanned air vehicles (UAVs), and tactical munitions.

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AF00T013 TITLE: Heat Reduction in Semiconductors

TECHNOLOGY AREAS: Information Systems, Electronics

OBJECTIVE: Find a way to use confined phonons to form coherent waves that can then be annihilated with a second stimulated wave of the opposite phase, possibly using pairs of quantum wells, for example. This has the potential to significantly reduce the cooling requirements of semiconductor lasers and detectors.

DESCRIPTION: Annihilation of phonons close to the active region of a laser would allow significantly higher pumping levels and power output for lasers used for infrared countermeasures. Lower noise detectors would also be enabled by this technology, increasing the sensitivity and reducing the weight for spaceborne platforms.

PHASE I: Experimental evidence of phonons confined by a quantum well points out the potential to advance cooling technology. Modeling would be required to predict which material system could exhibit desirable characteristics of phonon lifetime, mode occupation, etc. Modeling should examine various material systems, e.g. heterojunctions, quantum wells with any of the available band alignments, metal layers, etc.

PHASE II: Demonstrate lasers with power output greater than a factor of ten higher, long wavelength infrared detectors with no external cooling requirements.

PHASE III DUAL USE COMMERCIALIZATION: The expense and size of cooling is presently preventing the infrared spectrum from being used in many commercial applications including automotive, manufacturing, and medical.

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KEYWORDS: Semiconductors

AF00T014 TITLE: High Frequency Optical Wavefront Sensors

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Develop and demonstrate an improved high frequency two-dimensional optical wavefront sensor.

DESCRIPTION: Optical wavefront sensors are used to measure wavefront aberrations for a variety of applications. In adaptive optics systems, this information may be used to impose a conjugate wavefront on a deformable mirror. In other applications, this information may be used as a diagnostic tool to characterize the temporal and spatial aberrations arising from a turbulent flow process. Hartmann wavefront sensors are limited in their bandwidth by the frame-rate of CCD arrays and the post-processing algorithms applied to the collected frames. High frame rate CCD cameras can be costly components in these sensors, and the highest frame rate cameras typically do not provide a continuous throughput of frames. Lateral effect detectors have a higher bandwidth response and can provide continuous output, but do not provide a two-dimensional characterization of the wavefront. An ideal wavefront sensor would have high frequency response (50 kHz or more), high resolution (30 by 30), continuous output, and low cost.

PHASE I: Conceptually design the wavefront sensor and analyze the performance of the wavefront sensor using appropriate design tools. Demonstrate the operation of critical components in bench-level demonstrations.

PHASE II: Build and test a working prototype of system proposed in Phase I. Test and demonstrate the operation of the prototype in appropriate government, commercial or university laboratory setups. Characterize the frequency response and resolution of the wavefront sensor.

PHASE III DUAL USE COMMERCIALIZATION: An improved wavefront sensor will find application as a critical component in adaptive optical systems for military imaging systems. It will likely also find application in medical imaging systems, optical communications, and as a research tool for optical diagnostics.

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KEYWORDS: Optical Wavefront Sensors

AF00T015 TITLE: Automated Location of Structured Expertise in Very Large and Dynamic Information Repositories

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: Demonstrate that structured information can be located automatically in very large and dynamic information repositories, using concepts from data mining, and artificial intelligence.

DESCRIPTION: More and more information is available on-line, which makes the task of organizing information quite daunting. The clearest example of this is the common frustration with the overload of unstructured information provided by search engines. Although search engines for on-line information are improving rapidly, much less attention is being paid to the question of how to uncover the

hidden structure of information sources. A similar need for uncovering structure in information sources exists in large military operations, e.g., air campaign planning, that involve large numbers of documents in a relatively unstructured form.

The goal of this effort is to develop automated tools to locate and structure information on a particular topic. These tools should incorporate methods for data mining of on-line information sources to uncover the underlying structure of the information on a topic, its ontology and network of experts associated with the information. Searches for people and information can be structured according to relationships (for example, social or scientific relationships: find papers by colleagues of a well-known expert), as opposed to the flat, unstructured model used by current information retrieval engines.

An automated information and expertise locator system will be of value to the Air Force by facilitating the flow of information within the large highly distributed organization. Especially, given the dynamic nature of the Air Force organization, with people and units moving around frequently, dynamic tools for information location throughout the organization will be of significant value to the Air Force. The system can cover areas of technical expertise, for example, all information on air campaign planning for a certain region, as well as expertise involving organizational and management structure. Furthermore, it can be set up as an informal tool for providing crucial introductory information to new recruits or re-located personnel.

PHASE I: Phase I will investigate the development of data mining and information retrieval tools for locating information and uncovering its hidden structure in large information repositories.

PHASE II: Build and test a working prototype of system proposed in Phase I.

PHASE III DUAL USE APPLICATIONS: Phase III will test and evaluate tools for information discovery and structure identification in very large information repositories and commercialize results of Phase I and II. Accessibility to structured information increases choices for consumers in both civilian and defense application. This technology could have a major impact on applications that require the rapid integration of large amounts of information, such as needed in integrated decision making and timely and accurate information such as planning and scheduling systems and personnel military command and control. There is also significant commercial potential given the importance of large repositories of information such as the World Wide Web.

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AF00T016 TITLE: Space Ready Polymeric Materials

TECHNOLOGY AREAS: Materials/Processes, Space Platforms

OBJECTIVE: This STTR topic will seek research on polymeric materials designed for space applications. The research will also include the investigation of properties of these materials relevant to space applications.

DESCRIPTION: Lightweight is a critical parameter for space applications. Polymeric materials are lightweight and mechanically robust, making them ideal materials for space applications. Polymers can be used as matrix resins in fiber reinforced composite structures in satellites, liquid fuel tanks components in launch vehicles, and membranes in inflatable large space structures. With the advancement of polymers in electronic and photonic applications, this class of materials is also considered for non-structural applications in space. With some advanced concepts for future space structures, multifunctional structures that can serve both structural and functional purposes are envisioned. Unreinforced polymers can also be considered for future miniaturized space platforms such as the Microsats. This topic will seek research that can lead to development of "space-ready" polymeric material systems. Focuses will be on the durability of these materials in space application related environments. These will include, but not limited to, atomic oxygen and debris effects in low earth orbit for structural components, other radiation effects in higher orbits for photonic and electronic applications, and cryogenic temperature behavior in liquid fuel tank applications. Research on better understanding the material behavior in these environments with a clear connection to a material development effort in a later phase is acceptable.

PHASE I: Propose innovative chemical structures and/or chemical design concepts for space applications. Demonstrate appropriateness of these structures or design concepts for space applications.

PHASE II: Develop the proposed material technology and conduct appropriate testings to validate the appropriateness of the proposed chemical structures and/or chemical design concepts for space applications and progress towards commercial development of these chemical structures or concepts.

COMMERCIAL APPLICATIONS: Commercial space applications in communications, environmental sensing and weather monitoring.

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AF00T017

TITLE: Terahertz Devices

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Development of solid state terahertz devices for operation in the range between 0.3 THz to 10 THz that are suitable for coherent sources and detectors for use in space-based and short range terrestrial communications, atmospheric sensing, and near object analysis.

DESCRIPTION: The electromagnetic spectrum from 300 GHz to 10 THz is scientifically rich but relatively technologically poor. The region represents a gap separating electronics oriented towards transport, from photonics oriented toward quantum transistors. Devices that mix quantum and transport physics will fill this void. The region offers the potential for a number of applications including space-based and short-range terrestrial or near earth communications, atmospheric sensing, collision avoidance for aircraft and ground vehicles, and near object observation and spectroscopy. To realize this potential the appropriate sources, detectors, and systems need to be developed.

Innovative approaches are needed leading to the development, fabrication, and operation of coherent solid state terahertz sources. Efforts may include electrically excited devices as well as those driven by solid state optical lasers. Three terminal devices, and classical approaches, such as Gunn diode oscillators may be considered as long as proper power and efficiency advances are addressed. Highly desired are approaches in quantum wells and tunneling devices, as well as other novel quantum structure approaches. The goals of this effort are devices and device concepts that will deliver coherent radiation at potentially milliwatt power level, ultimately coupled efficiently in THz circuits, guided wave structures and antennas.

Work is needed in detectors to greatly improve the sensitivity, speed, and bandwidth. Specifically desired are efforts in semiconductor-based quantum well structures and the subsequent development of a useable detector that is narrow band, widely tunable, and yet highly sensitive. Other solid-state approaches may be considered. Approaches toward compact system modules addressing both generation and detection are also of interest.

PHASE I: Clearly demonstrate the feasibility of the proposed approach. Define device that will deliver up to milliwatts of coherent radiation at specified frequencies in the THz regime, and/or define the detector or detector structure detailing optimal geometry, bandwidth limitations, tunability, and current-carrying capacity. The definition of the device/ system-module needs to include principal of operation, material, processing, associated circuit or guided wave structure, and regime of operation.

PHASE II: Build upon Phase I work and demonstration of system components and implementation of a prototype. Perform appropriate analysis and modeling, grow the material or structure, fabricate the device and test its performance.

PHASE III DUAL USE COMMERCIALIZATION: Terahertz electronics and photonics have many potential applications. Covert communication on the battlefield or in space, chemical agent detection, atmospheric environment sensing, near object detection, material imaging will benefit from new technology in this part of the electromagnetic spectrum. New terahertz electronics will also make possible ultra high speed signal processing.

REFERENCES:

1. "Photon-assisted tunneling in a resonant tunneling diode: Stimulated emission and absorption in the THz range," Hermann Drexler, Jeff Scott, S.J. Allen Jr, K.L. Campman and A.C. Gossard; Applied Physics Letters, Volume 67, 4102 (1995)
2. "Inverse Bloch Oscillator: Strong Terahertz-Photocurrent Resonances at the Bloch Frequency"; K. Unterrainer, B.J. Keay, M.C. Wanke, S.J. Allen, D. Leonard, G. Medeiros-Ribeiro, U. Bhattacharya, and M.J.W. Rodwell; Physical Review Letters, Vol. 76, 2973-6 (1996).
3. "Transition from classical to quantum response in semiconductor superlattices at THz frequencies" , S. Zeuner, B.J. Keay, S.J. Allen, K.D. Maranowski and A.C. Gossard, U. Bhattacharya and M.J.W. Rodwell; Physical Review-B Rapid Communications, B53, R1717 (1996).
4. Terahertz links on the web: <http://www.bell-labs.com/user/igal/thzlinks.htm>
5. C. Waschke, H. G. Roskos, R. Schwedler, K. Leo, H. Kurz, and K. Koehler, Phys. Rev. Lett. 70, 3319 (1993).

KEYWORDS: Terahertz Devices

AF00T018

TITLE: Pulsed Detonation Propulsion Alternative for Space

TECHNOLOGY AREAS: Space Platforms

OBJECTIVE: The objective of this topic is to develop a concept for a pulsed detonation rocket engine suitable for space propulsion applications. Potential space applications for pulsed detonation propulsion include boost, upper stage, orbit transfer, divert, station keeping, and attitude control. Micropropulsion concepts will also be considered.

DESCRIPTION: In a pulsed detonation rocket engine (PDRE), a charge of propellants is introduced into a combustion chamber and allowed to premix. The mixture is then detonated, and impulse is gained from the event from the pressure built up on the back walls of the combustion chamber. Repetition rates reaching 140 Hz have been achieved for GH₂/GOX systems. Because detonation waves travel at thousands of meters per second, combustion is completed as something close to a constant volume process. The higher peak temperatures and pressures reached as a result can result in better performance than a conventional constant pressure device with the same feed system. An additional advantage of the pulsed detonation cycle stems from the fact that the combustion chamber pressure is low (near ambient) when the propellants are injected. In conventional rocket cycles, elevated pressures (reaching 3,500 psi in the space shuttle) are required in the combustion chamber in order to achieve adequate thrust. Large pumps are needed to inject the propellants against these pressures. The pulsed detonation cycle potentially reduces the pumping requirements significantly. This in turn considerably reduces the weight of the propulsion system and potentially improves its simplicity. It has been estimated that eliminating the turbopumps from the space shuttle main engine would reduce its weight by 24%, improve reliability by 27%, and reduce hardware costs by 20%. These are extraordinarily large numbers for a rocket propulsion system. Other advantages of the pulsed detonation cycle include the ability to throttle deeply and the potential to deliver impulse bits more precisely than competing cycles.

Numerous technical challenges will need to be overcome before PDRE's can be fielded, many of which, for instance the practical requirement to use liquid phase fuels, will be common to airbreathing applications. However, space propulsion introduces a number of unique additional challenges. For instance, as the ambient pressure approaches a vacuum, the potential performance advantages will probably not be as significant as at atmospheric pressure, although the potential to operate at lower feed system pressures remains. Filling the chamber and achieving detonations when the ambient pressure is a vacuum needs to be addressed, as well as materials compatibility and pre-ignition issues arising from the hotter operating temperature of a rocket. Space propulsion applications may offer unique opportunities as well, such as the opportunity to operate using oxidants other than air and the potential economies of using fuels and oxidants which are both in the liquid state.

PHASE I: A successful phase I effort will develop a PDRE concept for one or more of the space propulsion applications identified above. Technical challenges which need to be overcome to achieve the concept will be assessed, and plausible approaches to overcome the challenges will be identified. Modeling, experimentation, or both can be used to assess the concept. Suitable analysis will also be conducted to clearly demonstrate how the PDRE concept would be superior to existing or other possible ways to accomplish the selected mission.

PHASE II - A successful phase II effort will develop the concept into a working prototype which will demonstrate the performance of the concept.

COMMERCIAL POTENTIAL: Currently there is enormous commercial potential in space, and a PDRE concept with demonstrable superior capability for one or more of the above space propulsion applications would find a market in the commercial launch and satellite business. Further market opportunities would arise if the concept also has potential for airbreathing applications.

REFERENCES:

1. Kailasanath, K. "Applications of Detonations to Propulsion: A Review," 37th AIAA Aerospace Sciences Meeting and Exhibit, paper AIAA-97-1067, Reno, NV, 11-14 January 1997.
2. Bussing, T., and Pappas, G., "An Introduction to Pulse Detonation Engines," AIAA Paper 94-0263.
3. Cambier, J.-L., and Tegner, J.K., "Strategies for Pulsed Detonation Engine Performance Optimization," Journal of Propulsion and Power 14(4), pp 489-498,

AF00T019

TITLE: Computational Tools for the Sensitivity Analysis and Control of Combustion Instabilities

TECHNOLOGY AREAS: Air Platform, Information Systems, Space Platforms

OBJECTIVE: Develop computational tools for time accurate sensitivity analysis of combusting incompressible flows with finite rate chemistry. The tools must be suitable for use in design, optimization, and active control of combustors.

DESCRIPTION: Requirements for recently developed military engines have lead to increases in engine pressure ratios and fuel loading. These increases typically produce more instances of combustion instabilities. A similar trend can also be seen in industrial power generation gas turbines due to low NO_x requirements at both full and partial power conditions. Such instabilities can be directly related Low and High Cycle Fatigue in gas turbines. One approach to meeting new engine performance and maintenance requirements is to use modern optimization and control techniques to mitigate these combustion instabilities while maintaining required performance levels.

Historically, passive approaches have been applied to mitigate combustion instabilities. These attempts at attenuating instability were typically very costly in both man-years and dollars. The solutions were also very condition specific. Currently, active combustion control is being employed to control instabilities in basic and applied research settings. This approach is also being considered on industrial power generation gas turbines in the United States and abroad. A fundamental problem is the development of tools, which allow one to intelligently evaluate whether active or passive techniques are more suitable for a given design setting. Tools for the evaluation of the performance and correctness of implementation of various methodologies are needed. Incorrect answers can produce added expense to engine development, procurement, and operation and maintenance costs. A predictive capability is required to assess the sensitivity of combustion instabilities to various engine parameters. In addition, design tools are needed to optimize and control such systems.

Accurate determination of numerous parameter sensitivities is essential. Some important parameters, which need to be considered are turbulent length and time scales, chemical kinetic time scales, droplet spray and atomization time and length scales, geometry, sensor type, sensor placement, fuel and air actuation type and placement. Since active control is an important component of this work, time accurate design and simulation tools must be developed.

PHASE I: Develop steady state methodology to predict the sensitivity of the parametric factors, which contribute to the dynamic instabilities of combustion processes, which typically occur in gas turbine combustion systems. This methodology must be validated by comparison with available data.

PHASE II: Develop a time accurate methodology for computation of time dependent parameter sensitivities. Develop tools, which can be used to design, optimize, and, implement both passive and active controllers. Issues such as sensor and actuator placement and system performance must be addressed.

PHASE III DUAL USE COMMERCIALIZATION: Currently, there is a strong need for an accurate modeling capability for gas turbines; both military and industrial. These new computational tools will be beneficial in reducing development, operation, and maintenance costs, through optimization and control of instabilities.

REFERENCES: [1] Rayleigh, J. W. S., "The Theory of Sound", Vol II, Dover, NY, 1945

[2] Kim, Y. M., Chen, C. P., and Ziebarth, J., "Vaporization Effects on Combustion Instability of Liquid Fueled Engines", ICLASS-99, Washington D.C., 1991.

[3] Schadow, K. C., Gutmark, E., and Parr, D. M., "Large Scale Coherent Structures As Drivers of Combustion instability", Combustion Science Technology, VOL 64, Nos 4-6, 167-186, 1989

[4] Godfrey, A., Eppard, M., and Cliff, E., "Using Sensitivity Equations for Chemically Reacting Flows", AIAA-98-4805, St. Louis, MO.

KEYWORDS: Computational Tools, Sensitivity Analysis, Control of Combustion Instabilities

AF00T020 TITLE: High-Average-Power, Highly-Efficient, Visible-Wavelength, Solid-State Laser Sources

TECHNOLOGY AREAS: Materials/Processes, Electronics

OBJECTIVE: Develop a compact and efficient (continuous-wave or continuous-wave-modelocked) laser source with more than 100 W average output power tunable in the visible spectrum.

DESCRIPTION: The Air Force and DOD have numerous requirements for moderate to very high average power lasers, in space, airborne, and ground-based applications. Examples include weaponry, illumination, imaging, and remote detection of chemical and biological threats. At the present time, laser systems are individually developed, and are generally too costly and unreliable for most potential uses. An approach to this problem would be to develop generic laser systems which could be put together to get necessary power levels, and use nonlinear optical and other techniques, as necessary, to achieve necessary wavelengths and other characteristics. At the present time fiber, rod, and slab lasers based on such materials as Nd:YAG, Nd:YVO4, and Yb:YAG have reached average power levels at hundreds of watts at wavelengths near 1 micrometer. These lasers may be useful pump sources for nonlinear conversion to visible wavelengths. However, the optical power handling capabilities of current nonlinear optics (NLO) materials are often limited due to thermal effects caused by optical absorption. These effects become even more extreme at short (i.e., visible) wavelengths. Thermal-management techniques developed for laser-head cooling may be applicable to current NLO materials. Such use of advanced cooling concepts in NLO materials may enable higher output powers than is currently possible. The goal of this STTR topic is to design and demonstrate the feasibility of a compact, efficient, high-power, visible-output, solid-state laser/NLO light source.

PHASE I: Design and test feasibility of compact, efficient, high-power infrared laser source and NLO converter for generating tunable visible output wavelengths at the 100 Watt or greater levels.

PHASE II: Develop and test prototype of the concept(s) developed in the Phase I effort.

PHASE III DUAL USE COMMERCIALIZATION: The laser sources developed under this topic will have value to commercial manufacturers of displays, printers, adaptive optics systems and laser machining equipment. Ultra small systems meeting the criteria would have several commercial and military customers.

REFERENCES:

- (1) W. F. Krupke, "High-Average-Power, Quasi-Three-Level, Diode-Pumped Solid State Lasers", Proceedings of the Conference on Lasers and Electro-Optics, Technical Digest Series, vol. 6 (1998);
- (2) G.D. Miller, R.G. Batchko, W.M. Tulloch, D. R. Wiese, M. M. Fejer, and R. L. Byer, "42% Efficient Single-Pass CW Second-Harmonic Generation in periodically Poled LiNbO₃", Opt. Lett. 22, 1834-1836 (December 1997)

KEYWORDS: High-Average-Power, Visible-Wavelength, Solid-State Laser Sources

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Proposal Submission

DARPA's charter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the DARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential military and dual-use applicability as the budget and other factors will allow.

The topics published in this solicitation are broad in scope. They were developed to bring the small business community and research partners together to meet the technological needs of today. DARPA has identified 9 technical topics, numbered **DARPA ST00-001** through **DARPA ST00-009** to which small businesses may respond in the fiscal year (FY) 2000 solicitation. Please note that these topics are UNCLASSIFIED and only UNCLASSIFIED proposals will be entertained. These are the only topics for which proposals will be accepted at this time. Full topic descriptions, which originated from DARPA technical offices, are included.

Please note that **an Original and four copies** of each proposal must be mailed or hand-carried; DARPA will **not** accept proposal submissions by electronic facsimile (fax). A checklist has been prepared to assist small business activities in responding to DARPA topics. Please use this checklist prior to mailing or hand-carrying your proposal(s) to DARPA. Do not include the checklist with your proposal.

It is expected that the majority of DARPA Phase I awards will be Firm Fixed Price contracts. Phase I STTR proposals **shall not exceed \$99,000**, and are for approximately one (1) year efforts. DARPA Phase II proposals **must be invited** by the respective Phase I DARPA Program Manager (with the exception of Fast Track Proposals - see section 4.5). Phase II STTR awards will be limited to \$500,000, and it is expected that a majority of the Phase II contracts will be Firm Fixed Price-Level of Effort.

The responsibility for implementing DARPA's Small Business Technology Transfer (STTR) Program rests with the Office of Administration and Small Business (OASB). The DARPA SBIR/STTR Program Manager is Connie Jacobs. DARPA invites small businesses, in cooperation with a researcher from a university, an eligible contractor-operated federally-funded research and development center (FFRDC), or a non-profit research institution, to send proposals directly to DARPA at the following address:

DARPA/OMO/CMD/STTR
Attention: Ms. Connie Jacobs
3701 North Fairfax Drive
Arlington, VA 22203-1714

(703) 526-4170
Home Page <http://www.darpa.mil>

STTR proposals submitted to DARPA will be processed by DARPA OMO/CMD and distributed to the appropriate technical office for evaluation and action.

DARPA selects proposals for funding based on technical merit and the evaluation criteria contained in this solicitation document. DARPA gives evaluation criterion a., "The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution." (refer to section 4.2 Evaluation Criteria - Phase I - page 7), twice the weight of the other two evaluation criteria. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposal(s) is deemed superior, or it may fund no proposals in a topic area. Each proposal submitted to DARPA must have a topic number and must be responsive to only one topic.

In order to ensure an expeditious award, cost proposals will be considered to be binding for a period of 180 days from the closing date of this solicitation. For contractual purposes, proposals submitted to DARPA should include a statement of work which does not contain proprietary information. Successful offerors will be expected to begin work no later than 30 days after contract

award. For planning purposes, the contract award process is normally completed within 30 to 60 days from issuance of the selection notification letter to Phase I offerors.

On a pilot basis, the DoD STTR program has implemented a streamlined Fast Track process for STTR projects that attract matching cash from an outside investor for the Phase II STTR effort, as well as for the interim effort between Phases I and II. Refer to Section 4.5 for Fast Track instructions. DARPA encourages Fast Track Applications to be submitted during the last two months of the Phase I effort. Technical dialogue with DARPA Program Managers is encouraged to ensure research continuity during the interim period and Phase II. If a Phase II contract is awarded under the Fast Track program, the amount of the interim funding will be deducted from the Phase II award amount. It is expected that interim funding will not exceed \$40,000.

**DARPA FY 2000 Phase I STTR
Checklist**

1) Proposal Format

- a. Cover Sheet (identify topic number) _____
- b. Project Summary _____
- c. Identification and Significance of Problem or Opportunity _____
- d. Phase I Technical Objectives _____
- e. Phase I Work Plan _____
- f. Related Work _____
- g. Relationship with Future Research and/or Development _____
- h. Commercial Strategy _____
- i. Key Personnel _____
- j. Facilities/Equipment _____
- k. Consultants _____
- l. Prior, Current, or Pending Support of Similar Proposals or Awards _____
- m. Cost Proposal _____
- n. Company Commercialization Report _____
- o. Agreement between the Small Business and Research Institution (upon Contract Award) _____

2) Bindings

- a. Staple proposals in upper left-hand corner. _____
- b. **Do not** use a cover. _____
- c. **Do not** use special bindings. _____

3) Page Limitation

- a. Total for each proposal is 25 pages inclusive of cost proposal and resumes. _____
- b. Company Commercialization Report is not included in the page count. _____

4) Submission Requirement for Each Proposal

- a. Original proposal signed. _____
- b. Four photocopies of original proposal, including signed cover sheet and project summary. _____

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DARPA ST00-002	Dynamic Database for Biology Research
DARPA ST00-003	Extremely Low-Cost, Compact Wireless Network Interface Modules
DARPA ST00-004	Programming Support for Embedded Real-Time Systems
DARPA ST00-005	Adaptive Optics for Micro-Platforms
DARPA ST00-006	Imprint Tools for Patterning Nanostructures
DARPA ST00-007	Enhanced Electromagnetic Prediction Capabilities
DARPA ST00-008	Advanced Tracking Techniques for FOPEN GMTI Radars
DARPA ST00-009	Multi-Frequency/Multi-Phase Center SAR Processing for Foliage Canopy and Surface Clutter Suppression

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DARPA FY2000 STTR TOPIC DESCRIPTIONS

DARPA ST00-001

TITLE: Palm Power

KEY TECHNOLOGY AREA: Materials / Processes; Sensors, Electronics and Battlespace Environment; and Human Systems.

OBJECTIVE: Design and build a cost effective portable power system capable of delivering 5 W of continuous power for 72 hours with a maximum system mass of 0.5 kg. and system volume of one liter (including fuel, if necessary).

DESCRIPTION: Batteries are the primary power source for portable electronic devices. While the energy density and specific energy of batteries is increasing, scenarios are being developed that will require far more energy than can be delivered by batteries alone. Fueled systems are attractive because the energy content of many fuels is very high and only modest conversion efficiencies are required to greatly exceed the specific energy and energy density of batteries. The major challenge is scaling these systems down to sizes that can be carried or worn and used to power portable electronic devices such as communication radios or laptop computers. Load following capability for energy conversion devices in these size ranges add significantly to this challenge. In practice, hybrid systems that include rechargeable batteries are likely to emerge for these applications as the battery can handle peak power and air independent operation requirements. Small energy conversion devices will have a better chance of succeeding in the near term if the load following requirement can be relaxed. The focus of this solicitation is strictly on a prime power system that can meet the requirements stated above. It has been demonstrated recently that small direct methanol fuel cells stacks can deliver 60% of the performance of equivalent hydrogen/air stacks under mild operating conditions. At the system level direct methanol fuel cell performance could meet or exceed that of the hydrogen fuel cell when hydrogen storage and/or generation are included in the system weight and volume of the latter. While the direct methanol fuel cell might be an ideal technology to meet the goals of this solicitation, other technologies, e.g., thermoelectrics, thermionics, AMTEC, metal-air systems, etc. will be considered. Regardless of the technology, fuel materials choice must be compatible with consumer safety and transportation regulations and thermal and acoustic signatures must be extremely low. The final device must be amenable to manufacture at a reasonable price. This solicitation is for the development of the prime power generator and balance of plant (components necessary to control and provide reactant feed, product removal and thermal balance) only. No consideration will be given for the development of complete hybrid systems.

PHASE I: Demonstrate a breadboard system that will lead to a design capable of meeting the program objectives. The design must be supported by data obtained from breadboard testing.

PHASE II: Build and test a packaged system that meets the program objectives and can be stored and operated under military conditions. Deliver six complete systems for testing and evaluation.

PHASE III DUAL USE APPLICATIONS: These systems could be used for a wide range of man portable power applications, e.g., radios and laptop computers for military and consumer markets. In addition, they could be used as long endurance power sources for remote sensing and surveillance.

KEYWORDS: Energy Sources, Power Sources, Direct Methanol Fuel Cell, Static Energy Conversion.

REFERENCES: S. Gottesfeld, "Recent Advances In Direct Methanol Fuel Cells At Los Alamos National Laboratory", presented at the Sixth Grove Fuel Cell Symposium, 13-16 September 1999, London, England, and submitted to the Journal of Power Sources (1999).

DARPA ST00-002

TITLE: Dynamic Database for Biology Research

KEY TECHNOLOGY AREA: Biomedical

OBJECTIVE: Design and build a high performance knowledge based system for biology base query.

DESCRIPTION: Biomedical data is multifaceted, enormous in quantity, with new critical information, both in type and scope, being continuously generated. This information spans numeric, categorical (e.g. sequence databases) and visual types (e.g. photographs), as well as different sources, storage types, and formats. Current efforts (NIH, Celera Genomics, etc.) generate large amounts of raw data to populate databases. Special algorithms and labor-intensive transfer of data from primary databases are required for any non-standard analyses and significant effort is required to incorporate the results directly for immediate use. User-friendly software tools that provide users with the ability to add specialized annotations to rapidly expanding databases without requiring the writing of new programs are needed. These high performance knowledge based (HPKB) systems will allow researchers to focus on data mining, analyzing information in the database, and developing useful applications that rapidly access, process, and query biomedical information for key applications (e.g. drug design, pharmacogenomics, and modeling of cells and organs).

PHASE I: Develop a high performance database testbed for computational biology research

PHASE II: Develop and demonstrate a specific database query of significant interest to computational biology

PHASE III DUAL USE APPLICATIONS: Besides the medical applications of genomic sequencing and drug design, Dynamic Database tools can be applied to quick identification of chemical-bio agents.

KEYWORDS: Database, Data Mining, Biology.

REFERENCE: list of the major databases and links for genomics work:

1. http://www.ornl.gov/TechResources/Human_Genome/links.html#informatics

2. <http://www.unl.edu/stc-95/ResTools/biotools/biotools4.html>

The Genbank Sequence database at NIH

3. <http://www.ncbi.nlm.nih.gov/Genbank/index.html>

DARPA ST00-003

TITLE: Extremely Low-Cost, Compact Wireless Network Interface Modules

KEY TECHNOLOGY AREA: Information Systems Technologies

OBJECTIVE: To develop new techniques in RF, ultra-wideband and Infrared network interface technologies for the next generation compact wireless modules that are several orders of magnitude lower in cost and of miniature size and low-power needs.

DESCRIPTION: Extremely low cost, compact wireless network interface technology is a key to triggering a quantum shift in the types, volumes and roles of the devices that are attached to the global networking infrastructure. Such wireless input/output (IO) devices will support ubiquitous use of processors, sensors, and actuators in the environment enabling such applications as: Smart Battlefield, Collaboratories, Intelligent Highways/ Hospitals/Buildings, Geological and Environmental Monitoring. Crisis management centers, in response to events such as earthquakes, forest fires, floods or hurricanes, could quickly and effectively link sensors assessing damage to communication/processing devices carried by response teams to provide a systematic view of the situation and make informed decisions. "Guardian Angels" could autonomously monitor safety and health information related to high risk individuals (e.g., soldier or home care patients) and assets (e.g., aircraft). Today's wireless interface modules are limited both in terms of cost, size, and power requirements. Next generation modules that are several orders of magnitude lower in cost and of miniature size and low-power need to be developed. The operational transmission span of interest is in the range of few meters to low kilometers though a single module may or may not cover this entire range. Techniques in RF, ultra-wideband, and IR technologies need to be explored.

PHASE I: Begin a feasibility design study of cost reduction and performance prediction of compact wireless network interface module that can eventually be mass-produced at a very small fraction of cost compared to today's state-of-the-art. While the strongest emphasis is on the physical layer design, preliminary design analysis should be made for the link layer, network layer and transport layer processing. The physical layer implementation may be based on RF, ultra-wideband, infrared or any other viable spectral domain.

PHASE II: Integrate the sub-components into a network I/O module prototype and into an end-system prototype. Demonstrate functionality of the integrated system prototype in both a laboratory and outside environment that emulate real-world settings. Carry out a thorough testing and characterization study. Phase II must also include a prototype demonstration for key sub-components that make up the module. An analysis of the expected system performance within the parameters of interest and estimates of projected cost reductions by an order of magnitude anticipated is also strongly encouraged.

PHASE III DUAL USE APPLICATIONS: Commercialization of the system should be pursued in this phase. Chart a course for further improvements and refinement to the component and system design. Detailed study of usage in domain-specific applications is also highly encouraged. Industrial consortia or other standardization activities are also encouraged. The resulting technology could be directly utilized to connect sensors, actuators and communication devices into the Internet, and these end-devices may be widely and deeply embedded in homes, buildings, vehicles, urban and natural environments, or carried/worn by users.

KEYWORDS: Networking, Embedded Systems, Wireless Communications, Infrared Communications, Ubiquitous Networking

KEY TECHNOLOGY AREA: Information Systems Technologies

OBJECTIVE: Develop programming support technology that will simplify the introduction and assurance of essential properties of real time embedded software (e.g., deterministic timing, composability, fault tolerance, memory management, and synchronization) and assurance of domain-specific properties.

DESCRIPTION: Development of software for real-time embedded systems remains a highly labor-intensive and error prone process. Because of the physical constraints under which it must operate, embedded software must augment the code that realizes the system's intended functionality with code necessary to assure cross-cutting properties such as timing, fault-tolerance, and application-aware resource management (e.g., register, memory, and cache management). The nature of this "aspect" code requires that it (a) be customized to the underlying hardware platform; (b) be tightly interleaved with the functional code; and (c) be highly optimized to minimize overhead and interference. The considerable programming effort entailed in generating such code has led to hard-coded, application-specific, hand-tuned solutions that make the software brittle and vulnerable to inevitable changes in processor, board, and bus architectures and inhibit subsequent adoption of advances in subsystem or component technologies (e.g., sensors, actuators). As system functions are increasingly allocated to software, the problem of efficiently constructing large but robust and reliable embedded software systems becomes both a cost driver and a system risk factor. Current programming practice will not scale to future systems, particularly those that may depend on adaptive, mobile, embedded software. Automation of embedded software development will require tools that allow the programmer to separate the concerns of the aspect requirements from that of the functionality. Such tools, along with reusable aspect-enforcing mechanisms, such as protocols or services, would support rapid, reliable programming of cross-cutting aspects such as timing, fault tolerance, concurrency, synchronization, atomicity, storage hierarchy management, data persistence, and other demands. Research is therefore sought that enables tool-based introduction of these cross-cutting aspects into embedded functional code and provides assurance that the required properties are achieved. These tools should provide strong support for code analysis and transformation. Of particular interest are approaches that target mobile code and facilitate staged introduction of aspects.

PHASE I: Design a programming framework for embedded software that will enable aspect- and object-oriented software development, and property-based debugging. The framework should provide ground-breaking technology that radically simplifies programming and validation of real-time embedded software. For example, the environment should provide interpretation and analysis support to determine when cross-cutting aspects may interact. It should insert the required implementation mechanisms into the software, detect interference among properties, and aid the programmer in compensating for it. The framework should be populated with reusable protocols or service suites addressing timing properties and at least one additional cross-cutting aspect. Of particular interest are approaches that support domain-specific software development and real-time mobile code. Phase I products include (a) design of the overall framework; (b) description of key components including analysis and transformation tools, protocols, and service suites; (c) proof-of-concept demonstrations of key analysis and transformation algorithms; and (d) an experimentation plan for demonstrating the software development technology on a challenging and useful real-time embedded software problem.

PHASE II: Demonstrate the programming framework concept by implementing and applying it to the class of real-time embedded systems challenge problems defined in Phase I. A robust reference implementation of the framework should be completed. The programming framework should be exercised on several examples of the class of software chosen for the challenge area and on at least two different hardware platforms.

PHASE III DUAL USE APPLICATIONS: The technology produced must have a high probability of successful commercialization. Commercialization and commercial application of the real-time embedded programming framework should be pursued in this phase. Promotion of the programming technology through industrial consortia or other standardization activities is encouraged. Domain-specialization of the framework is also encouraged, e.g., for programming commercial embedded systems applications or consumer device product lines. Example applications might include manufacturing, environmental control, consumer electronics, medical devices, or automotive systems.

KEYWORDS: Embedded Systems, Real-Time Software, Aspect-Oriented Programming, Open Systems, Object-Oriented, Domain-Specific Languages, Programming Languages, Program Analysis, Program Transformation, Staging Analysis, Partial Evaluation, Micro-Protocols, Patterns, Model-Based Design.

DARPA ST00-005

TITLE: Adaptive Optics for Micro-Platforms

KEY TECHNOLOGY AREAS: Sensors, Electronics, and Battlespace Environment

OBJECTIVE: Development of novel devices for adaptive micro-optics, their integration with electronic signal processing, and demonstration of new system concepts.

DESCRIPTION: The capability to produce micro-mechanical devices has provided design engineers with a new tool to control and enhance the performance of a wide variety of air, ground and maritime systems. Incorporation of these micro-mechanical devices into the design of optical systems extends their application base, providing a novel method to control optical signals in an integrated, solid state package. Adaptive micro-optical devices can add the ability to correct, shape and direct the optical signals prior to electronic signal processing, dramatically increasing processing power and performing a pre-processing function not possible with electronic processing. Previous work in adaptive optics used the mechanical motion of large mirrors and optical elements to modify the shape and response of the optical system. The physical size and cost of these adaptive optical elements restricts their application and limits performance to large platforms. The advent of solid state, micro-mechanical fabrication technology can dramatically change adaptive optics technology. The micro-mechanical, solid state technology will allow design and implementation of precisely controlled optical elements, which can be modified in real time, to optimize the performance of the optical system and direct optical beams within the optical system. Micro-mechanical adaptive optics permit the fabrication of compact optical systems ideally suited for the micro-platforms planned for future military systems. These platforms include micro-air vehicles, robotics, munitions and even man-portable systems. Application of adaptive optics technology, previously reserved for large aperture systems, adds to these small platforms a new level of performance. Examples of specific performance enhancements include an optical transfer function tailored to compensate for atmospheric disturbance, correction of imperfections in the optical system, new methods of image enhancement, and the potential to perform multi-spectral imaging with adaptive optical elements.

PHASE I: Develop an overall system concept for the incorporation of adaptive optical components. For the concept selected, formulate one or more feasibility designs, identify key technologies fundamental to the design, determine critical device specifications, assess risk areas, and demonstrate the performance of devices critical to the design. Describe the advantages of the adaptive optics design for the selected system concept.

PHASE II: Implement a specific design concept through the demonstration of a prototype sub-system. The sub-system demonstration will include the fabrication of micro-optical components, integration of components into the sub-system and performance evaluation. Formulate the specifications for the integration of the micro-optical sub-system into application system.

PHASE III DUAL USE APPLICATIONS: Integrate the micro-optical sub-system with the final system, and demonstrate performance for the selected application. Verify performance parameters outlined in Phase I, and address the potential for dual use applications. Potential dual use applications may include, but are not limited to, long range imaging, including space imaging; and imaging for the detection of biological and chemical species.

KEYWORDS: Adaptive Optics, Imaging Systems, Night Vision, Infrared Imaging

REFERENCES:

General Reference:

1. The Infrared and Electro-Optical Systems Handbook; Volume 8; Emerging Systems and technologies; Editor Stanley Robinson; Defense Technical Information Center, DTIC-FF, Cameron Station, Alexandria, Virginia 22304-6145.

References to Specific State of the art Micro-Optics Research

2. Micro-optic Requirements for Optically Assisted Winchester Recording Heads; Heanue John; SPIE - The International Society for Optical Engineers; Vol. 3776

3. High Precision Micro-optical Elements by Wafer Scale Replication on Arbitrary Substrates; Dannberg, Peter et al; SPIE - The International Society for Optical Engineers; Vol. 3739.

DARPA ST00-006

TITLE: Imprint Tools for Patterning Nanostructures

KEY TECHNOLOGY AREAS: Sensors, Electronics and Battlespace Environment.

OBJECTIVE: Develop nanoimprint machines that are suitable for patterning structures with critical dimensions in the nanometer regime.

DESCRIPTION: Nanoimprint lithography (NIL) is becoming an important method for low-cost and high-throughput patterning of nanostructures. No imaging optics are needed so many of the limitations associated with projection optical lithography are eliminated. In NIL, patterns are formed directly in a thin deformable layer by pressing a master (stamp) into the layer. This is accomplished at elevated temperatures (up to 150 C) and pressures (up to 300 pounds per square inch (psi)). However, no commercial tools are currently suitable or available for NIL. For example, commercially available presses cannot achieve the

large-area uniformity needed for NIL and are not suitable for operation in a clean room environment. Furthermore, current commercial presses have a cycling time that is orders of magnitude longer than that required for a reasonable throughput with NIL. To make NIL a real manufacturing technology, it is essential to develop presses with the appropriate characteristics.

PHASE I: Perform a design study of NIL tools that offer the needed large-area uniformity ($>4''$, scalable to $8''$), cycling time (<5 min, scalable to <2 min), imprint pressure (max 300 psi) and imprint temperature (max 150 C), with clean-room compatibility. Identify the key parameters and application areas for such tools.

PHASE II: Develop the NIL tool prototype(s) according to the design study in Phase-I. Build and test prototype, and refine the design. Perform application driven demonstration. Design and develop automatic control system.

PHASE III DUAL USE APPLICATION: The new NIL tools will enable the manufacturing of many key military and civilian high-performance nanodevices, which are currently too expensive to manufacture with conventional technology. These devices include high-frequency Metal Semiconductor Field Effect Transistors (MESFETs), mass storage, optical filters, and other optical signal processing elements.

KEYWORDS: Sensors, Nanostructures, Imprint, Nanodevices

REFERENCE: Several papers describing NIL can be found in the Journal of Vacuum Science of Technology volumes B16(6), Nov/Dec 1998, and B17(6), Nov/Dec 1999.

DARPA ST00-007

TITLE: Enhanced Electromagnetic Prediction Capabilities

KEY TECHNOLOGY AREA: Sensors

OBJECTIVE: Develop and exercise rigorous radio frequency electromagnetic scattering code to predict and explain the backscatter properties of physical objects and various backgrounds. From insights gained by exercising the model throughout ranges of parameters, propose possible parametric features for classifying background types and object classes.

DESCRIPTION: Computational electromagnetics has shown considerable success at predicting radar returns from certain classes of target objects, when dealing with X band radar and typical operating characteristics [see reference 1]. New technology has made advances that considerably extend the operating environment of future radar systems. These advances include wideband electronics, new signal processing methods, and advanced algorithms. Ultrahigh resolution synthetic aperture radar (SAR) is available at X band and higher, and lower wavelengths are also now feasible for radar, where penetration of dielectric materials such as foliage and certain types of soil is possible. Ultra wideband (UWB) radar testbed's are now becoming available to validate the utility of such a sensor for detecting obscured targets. SAR imaging systems are typically used to detect targets [see reference 2]. Early empirical evidence supports the hypothesis that many objects found pervasively in nature will not return significant energy to such low wavelength radar. For instance, tree canopy and various grasses have very little backscatter at UHF frequencies and below. Alternately, large girth trees and other combinations of naturally occurring background are seen to have appreciable backscatter characteristics. These objects compete directly with man made targets for the attention of most modern target detection algorithms. Further complications ensue because of the wide variety and diversity of naturally occurring clutter, and due to the availability of wideband sensing systems. Computational electromagnetic code for these new operating environments would have applicability to (1) supplement data collections, obviating unrealistically expensive measurement programs, (2) algorithm development, by providing insight into phenomenology of RF returns, and (3) sensor design, by leading to better performance predictions through modeling, without expensive point designs. The developed code could be used to predict both the signatures from man made objects, and clutter which is widely diverse and statistical in nature. The insights available from a thorough evaluation of both target and clutter return as a function of illuminating angle, frequency and polarization basis would allow the developing of enhanced discrimination features in various detection algorithms under development at contractor and government facilities today. Through the development of advanced feature sets, high performance detection algorithms would be available for the UWB radar of tomorrow.

PHASE I: Develop and prototype electromagnetic predictive code that expands the range of applicability of existing methods. Apply the technique for one or more target vehicles and one or more clutter classes. Identify metrics for validating the predictive capability of the code versus actual measured data.

PHASE II: Develop and validate code, and exercise the model through a wide variety of target and clutter occurrences. Provide detailed findings on the backscatter properties of each class in terms of frequency, angle and polarization state. Propose an advanced feature set for use in characterizing background and object classes.

PHASE III DUAL USE APPLICATIONS: UWB radar will increasingly have commercial viability, and has the potential to provide remote sensing for a variety of agricultural, geo-physical and commercial applications. Examples abound and include the use of such a radar for: Detection of underground pipes and wires—a priority requirement for most electric and gas utility companies; determination of the maturity and harvest potential of crops such as trees grown for lumber; etc. Rigorous models, when available, would permit industry to assess the utility of UWB radar technology for these (and other) applications.

KEYWORDS: Sensors, Radar, Ultra Wideband, Synthetic Aperture Radar, Automatic Detection, Computational Electromagnetics.

REFERENCES:

1. D. J. Andersh, S. W. Lee and H. Ling, "high frequency electromagnetic scattering prediction code using shooting and bouncing rays," accessible at <http://www.demaco.com/papers/sbr1/>.
2. Chris Oliver and Shaun Quegan, *Understanding Synthetic Aperture Radar Images*, Artech House.

DARPA ST00-008

TITLE: Advanced Tracking Techniques for FOPEN GMTI Radars

KEY TECHNOLOGY AREA: Sensors, Electronics and Battlespace Environment

OBJECTIVE: Develop innovative target tracking algorithms and sensor resource management techniques for application in airborne foliage penetration (FOPEN) radars.

DESCRIPTION: Airborne FOPEN radars are currently being studied by DARPA to detect and track ground moving targets on tree-lined roads and in wooded areas. These radars will operate at VHF or UHF to penetrate foliage. Even at these low frequencies, however, the foliage attenuation and backscatter will cause the target returns to have low signal-to-clutter-plus-noise ratios (SCNRs). FOPEN Ground Moving Target Indication (GMTI) radars will differ from conventional GMTI radars. First, they will have longer coherent integration times and coarser range and azimuths resolutions than conventional radars. Also, due to their broad beam widths, FOPEN radars will provide either very high target update rates or possibly even continuous target observations. Finally, the bandwidth of FOPEN GMTI radars may be limited to about 30 MHz due to spectrum allocation constraints. This might prohibit the use of high range resolution techniques to perform target association. However, FOPEN radars could provide multiple polarization (e.g. HH, VV and HV) data to enhance look-to-look target association. Tracking targets in heavily foliated areas will require new tracker concepts. The tracker must accommodate low SCNRs, high false alarm rates and false tracks. Furthermore, roads in wooded areas are likely to be much more winding than highways. It is therefore likely that traffic will exhibit continual changes in velocity, which exacerbates the tracking problem. Also, even with a FOPEN capability, the target visibility will occasionally cease, causing track dropouts that can severely impact performance if not properly handled. Innovative tracking concepts and algorithms are needed to realize the full potential of a FOPEN GMTI system. One approach for enhancing FOPEN radar performance might be to interface the tracker and the radar through a sensor resource manager (SRM). The SRM would control the waveform, coherent integration time, beam dwell time and target revisit rate to optimize performance. Additionally, a FOPEN GMTI radar might operate in concert with a passive ESM sensor to associate target emissions. Also SAR images, digital terrain elevation databases, land use and land cover databases, vector feature databases and other data about the area under surveillance might also be available to improve the tracking performance. FOPEN GMTI radar operation is discussed in Reference 1. FOPEN SAR imagery can be made available by DARPA. Additional databases can be obtained from the NIMA web site.

PHASE I: Develop an innovative concept for tracking targets with a FOPEN GMTI radar that has a relatively high false alarm rate and experiences frequent track dropouts. Show the benefits of utilizing additional data such as terrain databases, road locations, SAR images and ESM reports. Determine how an SRM might use these tools to enhance tracker performance.

PHASE II: Perform a software design of the Phase I tracker / SRM concept. Conduct computer analyses and demonstrate the tracker concept using realistic computer simulation techniques. Exercise the simulation to identify performance gains, risks and potential weaknesses.

PHASE III DUAL USE APPLICATIONS: The tracker techniques will be directly applicable for systems that track vehicles and personnel under foliage. Such systems are used in military operations, peace keeping missions, counter-drug operations, etc. The trackers could also be applied to civilian systems such as the airport surface detection equipment (ASDE-3) radar to enhance the monitoring of ground traffic in a severe clutter and multi-path environment.

KEYWORDS: FOPEN Radar, GMTI Radar, Target Tracking, Sensor Management.

REFERENCES: FOREST (FOPEN Radar and ESM for Targeting) Presentation to Industry (Available on DARPA web site).

DARPA ST00-009

TITLE: Multi-Frequency/Multi-Phase Center SAR Processing for Foliage Canopy and Surface Clutter Suppression

KEY TECHNOLOGY AREA: Sensors, Electronics

OBJECTIVE: Evaluate the potential of applying multi-phase center and/or multi-frequency SAR processing to suppress canopy clutter and surface clutter in support of detection of targets through foliage or in shallow underground hide.

DESCRIPTION: The capability of airborne SARs to perform foliage and ground penetration is severely limited by the strength of the "first surface" return. Conventional SAR imaging cannot separate this first surface scatter from the target backscatter by penetrating radiation. This is because there is insufficient independent information available from the single phase center used to form the synthetic aperture. The potential exists for enhancing selected targets beneath the first surface by acquiring multiple-aperture, and/or multiple-frequency data. This data could be processed in a manner to suppress the first surface scatter, which will provide a significantly enhanced view of an object beneath the foliage or surface. The purpose of this effort is to explore the data collection geometries, high-frequency and low-frequency assumptions, and signal processing options for suppressing the first surface scatter. Example techniques and concepts include:

- (1) Use multiple apertures to generate a "interferometric images" to isolate the source of the penetrating backscatter.
- (2) Use multiple polarization data (where available) to examine the capability for extracting "preferred polarization" geometries.
- (3) Examine unexplained energy residuals that may be attributable to dispersion due to propagation through a frequency-dependent dielectric.

PHASE I: Perform a feasibility study of the phenomena involved with one or more types of multiple-parameter (e.g. aperture, polarization, and frequency) SAR imagery. Develop imaging concepts and data processing techniques that could collect and exploit the multiple-parameter data. Make theoretical predictions to show the benefits of the proposed techniques.

PHASE II: Generate prototype algorithms for the techniques that appear to have the potential to improve the SAR image characteristics. The prototypes should be developed using software tools such as MATLAB. Apply the algorithms to either data that will be provided by DARPA or to data obtained through other sources to confirm the theoretical performance predictions. Formalize the algorithms in a language such as C or C++ to provide maximum speed and flexibility. Quantify the capabilities of the best performing concepts.

PHASE III DUAL USE APPLICATIONS: The successful demonstration and software instantiation of the multi-parameter SAR imaging technologies will provide the capability to improve the accuracy of topographic maps. It will also improve the imaging of buried objects such as pipes and electrical conductors. The techniques would also benefit the conducting of search-and-rescue missions and performing other such radar mapping activities from an airborne platform. The technology would also have a humanitarian application in locating mine fields in areas such as the Balkans and Southeast Asia.

KEYWORDS: FOPEN SAR, Interferometric SAR, Ground Penetration Radar, Polarimetric Processing

REFERENCES:

1. B. C. Brock and W. E. Patitz, "Optimum Frequency for Subsurface-Imaging Synthetic Aperture Radar", Sandia Report SAND93-0815, Sandia National Laboratories, Albuquerque, NM, May 1993.
2. Ken King Jao, Check F. Lee, and Serpil Ayasli, "Coherent Spatial Filtering for SAR Detection of Stationary Targets", *IEEE Transactions on Aerospace and Electronic Systems*, Vol. 35, No. 2, April 1999, pp614-626.
3. Davis, M. E., Tomlinson, P.G. and Maloney, R. P., "Technical Challenges in Ultra-Wideband Radar Development for Target Detection and Terrain Mapping", *Proceedings of the 1999 IEEE Radar Conference*, April 1999.

BALLISTIC MISSILE DEFENSE ORGANIZATION (BMDO)
SMALL BUSINESS TECHNOLOGY TRANSFER PROGRAM
Submitting Proposals – 2000 Instructions

Send Phase I proposal packages (the unbound original, to make extra copies, and six bound copies (i.e. stapled), to immediately forward to evaluators, of the full proposal, **PLUS** one additional copy of the Proposal Cover Sheet only (formerly "Appendices A and B") by US mail (or any commercial delivery service). Also, the Company Commercialization Report (formerly APPENDIX E) needs only to be with the unbound original. **DO NOT** attach the Company Commercialization Report to the six bound copies. The mailing address follows and the BMDO SBIR/STTR website address is provided.

Ballistic Missile Defense Organization
ATTN: STR/SBIR (BOND)
1725 Jefferson Davis Highway, Suite 809
Arlington, VA 22202

For Administrative HELP ONLY call: **800-WIN-BMDO**
Internet Access: **www.winbmdo.com**

Proposals delivered by other means will not be accepted. Proposals received after the closing date will not be processed. BMDO will acknowledge receipt of proposals, **IF AND ONLY IF**, the proposal includes a self-addressed stamped envelope and a form that needs no more than a signature by BMDO.

Proposers are required to register on the DoD Electronic Submission Website (<http://www.dodsbir.net/submission>) and, as instructed on the website, to prepare a BMDO Proposal Cover Sheet and Company Commercialization Report to be included in their proposal.

BMDO is working toward developing and deploying a ballistic missile defense system and providing a technology base that will allow the Department of Defense to protect the warfighters against increasingly sophisticated and lethal missiles around the world. BMDO accomplishes these efforts through three broad mission focus areas: Theater Missile Defense (TMD), National Missile Defense (NMD), and Advanced Technology Developments (ATD).

TMD systems respond to and protect U.S. forces, allies, and other countries from existing and emerging short to medium range threat missiles, including cruise missiles. Six Major Defense Acquisition Programs represent the majority of BMDO investments: PATRIOT Advanced Capability-3 (PAC-3), Navy Area Theater Ballistic Missile Defense (TBMD), Theater High-Altitude Area Defense System (THAAD), Navy Theater Wide, Medium Extended Air Defense System (MEADS), and the National Missile Defense (NMD). NMD is concerned with the possibility of a limited ballistic missile strike against the United States (all 50 states). The key component systems currently under consideration include: ground-based interceptors; ground-based radars; upgraded early-warning radars; forward-based X-Band radars; battle management, command, control, and communications (BMC3); and advanced sensor technology developments. External elements to NMD include the existing early warning satellite system and its planned follow-on: the Space Based Infrared System (SBIRS) which include both the HIGH and LOW components. Finally, BMDO depends on advanced technology developments, of all aspects, to invigorate its ability to implement both TMD and NMD systems in response to increasingly sophisticated ballistic missile threats, to include cruise missiles. Therefore, the continued availability of such advanced technology developments has become an increasingly vital and critical element of the overall BMDO mission.

The intent of BMDO, first and foremost, is to seek out the most innovative technology that might enable a defense against a missile -- lighter, faster, stronger, more reliable, and less expensive technologies are all of interest. Proposing companies need not know specific details or requirements of possible BMDO systems, research and development goals, or specific technology needs or requirements, but must understand that potential technologies should have application and be relevant to ballistic missile defense at some level. (A better fire

extinguisher, although it may be new and innovative and exhibit a potential commercial market, does not support ballistic missile defense requirements at any level.) All topics seek to solicit Research or Research and Development proposals from the small business community. Furthermore, all selections shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not yet been fully established.

Specifically, **BMDO seeks to invest seed-capital, which supplements private sector co-investment support, in a product with a future market potential (preferably private sector) and a measurable BMDO benefit.** The BMDO SBIR/STTR Program will neither support nor further develop concepts **already mature enough to compete** for private capital or for mainline government research and development funds. BMDO prefers projects that move technology into the private sector market by a market-oriented small company with the best demonstration of volume commercialization with private sector co-investments. Phase I proposals should focus primarily on the innovation of the proposed technology. Proposals should illustrate the concept or feasibility, and the merit of a Phase II for a prototype or at the very least a proof-of-concept. Phase II competition will also be judged intensely on future market possibilities and commercialization potential demonstrated. The demonstration of commercialization potential is best evidenced by Phase II funding commitments, public or private, submitted as part of the Phase II proposal. BMDO evaluates the presence of other indicators of commercialization potential, but only: 1) support-in-kind from private sector sources, and/or 2) a company's self-investment are considered appropriate other indicators by BMDO in assessing the private sector commercial potential of Phase II proposals.

BMDO does not specifically require co-investment in Phase II, and expects to make some Phase II awards in which the co-investment is not a factor in the selection decision each year. However, co-investment is strongly encouraged, and historically, the best companies with the best proposals demonstrate the commercialization potential of their technology by exhibiting private sector co-investment support, at some level, and/or the commitment of a government program willing, as part of the Phase II, to co-invest and leverage the SBIR/STTR investment at the time of selection. This co-investment standard is now set by the proposing companies, your competition, by attracting an average of a dollar-for-dollar match (1:1) of private sector co-investment support to the SBIR/STTR funding requested. Those companies, that do not demonstrate the commercial potential of their Phase II technology through a co-investment arrangement and/or other means, do not compete well at BMDO.

Phase II proposals may be submitted anytime, for any amount, in any format after the Effective Date of the Phase I effort. Unique efforts showing time sensitivity or submitted for *FasTrack* will be given due consideration for Phase II start-up funding and Phase I proposals may include a post-Phase I optional tasking that will permit rapid start-up if the Phase II or *FasTrack* application is approved. The latest information on how BMDO implements its *FasTrack* Program may be found on page BMDO-4 of this solicitation and at the website address under the *FasTrack* or Frequently Asked Questions (FAQs) sections.

BMDO implements a Phase II Enhancement policy across all SBIR/STTR selections by providing some initial funding and then matching private sector co-investments at some ratio and up to some ceiling. BMDO reserves the right to provide less funding than the company initially proposes. To encourage the transition of SBIR/STTR technology into DoD acquisition programs, additional government, non-SBIR or non-STTR, funding may be applied to any existing BMDO SBIR/STTR Phase II contract with **no ceiling**, under BMDO's Phase II Enhancement policy. These arrangements, however, must be coordinated through the managing agency implementing the contract. Also, a company that exhibits a unique and compelling rationale may receive additional Phase II SBIR funding to attract a significant level of private-sector funding as co-investment. These Phase II extensions or "add-ons" shall only occur to existing Phase II efforts and are treated on a case by case basis. BMDO, on the average, approves only one Phase II extension per year.

A Principal Investigator at the small business who is tenured faculty is **NOT** considered primarily employed by a small firm if they receive any compensation from the university while performing the SBIR or STTR contract; any waiver must be requested explicitly with a justification showing a compelling rational and national need; BMDO expects to grant no such waivers.

BMDO intends for a Phase I to be only an examination of the merit of the concept or technology, that still involves technical risk, with a cost under \$65,000. Although proposed cost will not affect selection for negotiation,

contracting may be delayed if BMDO reduces the proposed cost. **DO NOT** submit the same proposal, or variations thereof, to more than one BMDO topic area; each idea will be judged once in an open competition among all proposals. Furthermore, BMDO performs numerous cross-reference checks within each solicitation and with other DoD components. It is suggested that you **do not** use the title of the BMDO SBIR/STTR Topic as the title of your Phase I proposal.

Because BMDO seeks the best nation-wide experts in innovative technology, proposers may suggest technical government reviewers by enclosing a cover letter with the name, organization, address, phone number, and rationale for each suggestion. BMDO promises only to consider the suggestion and reserves the right to solicit other evaluations.

Implementation of DoD's Fast Track Policy at BMDO

Rationale for BMDO's Implementation Plan

The Defense Department's SBIR/STTR program has implemented a Fast Track policy for companies which, during their Phase I efforts, attract outside investors (government or private sector) that will match Phase II SBIR/STTR funding, in cash, at the matching rates described in the solicitation. Companies that obtain such outside cash investments and qualify for the SBIR/STTR Fast Track receive:

- a significantly higher chance of Phase II award, and
- interim funding between Phase I and Phase II, as well as expedited processing, to ensure no significant funding delays between Phases I and II.

The following summarizes how the DoD Fast Track policy is implemented at BMDO. This Implementation Plan is specifically required since the BMDO SBIR/STTR Program has evolved to the level that most companies competing for a Phase II award from BMDO obtain private-sector co-investment support – not just companies participating in the Fast Track. In fact, the BMDO SBIR/STTR Program, in its decision process for Phase II award selections, uses as a primary selection criterion (but not the only criterion) a company's ability to demonstrate commercial potential by attracting private-sector investment support during the performance of the Phase II. The value that BMDO places on this support depends on a number of factors, including the type of investment support (e.g. cash, support-in-kind, or self-investment), amount of the matching support, and timing of the matching support.

Thus, implementation of the DoD Fast Track policy at BMDO needs to occur in such a way that Phase II proposals with the greatest commercial potential, as measured by the amount of private-sector co-investment support, receive the highest priority for Phase II award.

BMDO's Fast Track Implementation Plan – "*FasTrack*" – has been in effect since the FY96.1 DoD SBIR solicitation and the FY96 DoD STTR solicitation and is approved for implementation by the Under Secretary of Defense for Acquisition and Technology (USD(A&T)).
BMDO's *FasTrack*:

- is consistent with the general principles of the DoD Fast Track policy, described above; and
- has demonstrated a track record of success. Specifically, BMDO implemented its *FasTrack* policy during 1996-1999 using the procedures outlined below, with the approval of the USD(A&T). 38 Phase I projects qualified for BMDO *FasTrack* during this time period -- the highest amount per dollar of SBIR funds of any DoD SBIR component. 37 of these projects were selected for Phase II award and also received interim funding between Phase I and Phase II.

The BMDO *FasTrack* Implementation Plan

a. In General. BMDO implements a *FasTrack* SBIR/STTR process for companies which, during their Phase I projects, attract one or more private-sector, outside investors that will match Interim SBIR/STTR Funding (between Phase I and Phase II) and Phase II SBIR funding, in cash, and at the matching rates described in subsection (c) below. Such companies shall receive (subject to the qualifications described herein):

- (1) Interim Funding of \$30,000 to \$40,000 between Phase I and Phase II;
- (2) BMDO's highest priority for Phase II selection and award; and
- (3) An expedited Phase II selection decision and an expedited Phase II award.

Questions about the BMDO *FasTrack*, including any of the provisions discussed below, should be directed to the BMDO SBIR/STTR Program Manager, Mr. Jeff Bond, at 703-604-3538 (FAX -3956). The BMDO SBIR/STTR Home Page contains a BMDO *FasTrack* Timeline showing the schedule of events for a company participating in BMDO's *FasTrack* program (see <http://www.winbmdo.com>).

b. How to Qualify for BMDO *FasTrack*. To qualify for BMDO *FasTrack*, a company that has received a BMDO-sponsored Phase I award must submit the following five items within four (4) months of the effective date of the Phase I award. (Note: The effective date is the date on which the Phase I contract actually takes effect and the company may begin to incur costs under the contract.):

- (1) A completed DoD/BMDO *FasTrack* application form (which follows this Plan). A copy of the completed DoD/BMDO *FasTrack* application must also be sent to the DoD SBIR/STTR Program Manager at the address listed on the back of the form.
- (2) A Commitment Letter from a private sector, outside investor (or investors) – such as another company, a venture capital firm, or an “angel” investor – stating that the investor(s) will match the Interim Funding and the Phase II funding, in cash, at the matching rates listed in subsection (c) below. The investment must qualify as a “Fast Track investment,” and the investor as an “outside investor,” as defined in Reference G of the SBIR or STTR solicitation (i.e. the investor cannot be an affiliate of the small company). Additionally, under BMDO *FasTrack*, federal, state, and foreign governments do not qualify as valid investors.

The Commitment Letter should state that the investor's funds will pay for work that is connected to the specific SBIR/STTR project, and should also describe the general nature of that work. The work funded by the investor may be additional research and development on the project or, alternatively, it may be other activity related to the project (e.g., marketing) that is outside the scope of the SBIR/STTR contract. The investor may provide its matching funds to the company contingent on the company's being selected for Phase II (procedures for accomplishing this must be discussed with the BMDO SBIR/STTR Program Manager, Mr. Jeff Bond, at 703/604-3538).

- (3) A concise Statement of Work and Cost Proposal for the Interim Funding effort (typically less than 4 pages in length).
- (4) An Executive Summary of the current status of the Phase I effort (typically less than 4 pages in length).
- (5) A copy of the first page of the Phase I contract (i.e. the signature page).

Additionally:

- (1) The company must submit its Phase II proposal within five (5) months of the effective date of the Phase I award;

- (2) The company must submit a Private Sector Investment Certification (PSIC) within seven (7) months of the effective date of the Phase I award, indicating that the investor's matching funds have been transferred to the SBIR/STTR company. The PSIC consists of: (a) a letter, signed by the investor and the company, that states the amount of cash that has been transferred; and (b) documentation to substantiate that the transfer of funds has occurred (e.g. a bank statement, wire transfer, or copies of canceled checks).

If not all the investor's funds are transferred to the company by the end of the seventh month, the company will still qualify for the *FasTrack*. However, it will receive a lower preference for Phase II selection than other *FasTrack* participants, as described in subsection (e) below. Additionally, BMDO will match any investor funds transferred to the company after the seventh month at only a \$1 to \$1 matching rate, rather than at the more favorable matching rates listed in subsection (c) below. Also, BMDO will only provide installments of Phase II funds to the company after corresponding installments of matching funds have been transferred from the investor to the company. (e.g. The company and investor must certify that \$60,000 in matching funds has been transferred to the company before BMDO will release a corresponding \$60,000 installment of Phase II SBIR/STTR funds.)

A company which fails to meet these conditions in their entirety within the time frames indicated will generally be disqualified from BMDO *FasTrack* consideration. If disqualified, the company shall still be eligible to compete for a "standard" Phase II award through the regular BMDO Phase II procedures with no penalty.

c. Matching Rates. BMDO *FasTrack* matching rates differ slightly from the matching rates under the DoD Fast Track policy. The BMDO rates are as follows:

- (1) For SBIR/STTR companies that have 10 or fewer employees and have never received a Phase II SBIR or STTR award from any federal agency, the investor's Commitment Letter must state that the investor shall provide at least \$1 to match every \$4 of Interim SBIR/STTR Funding and Phase II funding. (e.g. If the company proposes Interim SBIR/STTR Funding of \$40,000 and Phase II SBIR/STTR funding of \$600,000, the investor must provide a commitment of matching funds of \$10,000 and \$150,000 respectively for the two efforts.)
- (2) For SBIR/STTR companies that have received fewer than five (5) Phase II SBIR/STTR awards from the federal government, and do not fall into category (1) above, the investor's Commitment Letter must state that the investor shall provide at least \$1 to match every \$2 of Interim SBIR/STTR Funding and Phase II funding. (e.g. If the company proposes Interim SBIR Funding of \$40,000 and Phase II SBIR/STTR funding of \$600,000, the investor must provide a commitment of matching funds of \$20,000 and \$300,000 respectively for the two efforts.)
- (3) For SBIR/STTR companies that have received five (5) Phase II SBIR/STTR awards or more from the federal government, the investor's Commitment Letter must state that the investor shall provide at least \$1 to match every \$1 of Interim SBIR/STTR Funding and Phase II funding. (e.g. If the company proposes Interim SBIR/STTR Funding of \$40,000 and Phase II SBIR/STTR funding of \$600,000, the investor must provide a commitment of matching funds of \$40,000 and \$600,000 respectively for the two efforts.)

d. Benefits of Qualifying for BMDO *FasTrack*. A company that qualifies for BMDO *FasTrack* will:

- (1) Receive Interim Funding of \$30,000 to \$40,000 between Phase I and Phase II (However, the Interim Funding plus the Phase I award shall not exceed \$100,000).
- (2) Receive BMDO's highest priority for selection for Phase II award. Specifically, BMDO shall select the company for Phase II award assuming its project meets or exceeds a "technically sufficient" level, as described in Section 4.3 of the current solicitation. As discussed in subsection (e) below, among *FasTrack* companies, those that receive all of their investor matching funds within seven months after the effective start date of Phase I receive higher preference for selection than *FasTrack* companies that receive some or all matching funds after the seventh month.

- (3) Receive notification of whether it has been selected for Phase II award within 60 days after the completion of its Phase I project.
- (4) If selected, receive its Phase II award within an average of five months after the completion of its Phase I project, to ensure no significant funding delay between Phase I and Phase II. (Note: Although BMDO makes all of its Phase II selection decisions, the Phase II contracts are processed by other DoD organizations, and BMDO therefore does not directly control the timing of the contract awards. However, most BMDO *FasTrack* awards have been made within five months after the completion of the Phase I effort.)

e. BMDO *FasTrack* Preference Levels. As discussed above, companies that qualify for the BMDO *FasTrack* receive BMDO's highest priority for Phase II selection and award. Among *FasTrack* companies, those that receive all of their investor matching funds within seven months after the effective start date of Phase I receive higher preference for selection than *FasTrack* companies that receive some or all matching funds after the seventh month, as follows:

Preference Level 1 applies to *FasTrack* companies that receive all of the matching funds for the Interim effort and the Phase II effort within seven months after the effective start date of the Phase I award.

Preference Level 2 applies to *FasTrack* companies that receive all of the matching funds for the Interim effort but only some of the matching funds for the Phase II effort within seven months after the effective start date of the Phase I award.

Preference Level 3 applies to *FasTrack* companies that receive all the matching funds for the Interim effort but none of the matching funds for the Phase II effort within seven months after the effective start date of the Phase I award.

U.S. DEPARTMENT OF DEFENSE / Ballistic Missile Defense Organization
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
FAST TRACK APPLICATION FORM

Failure to fill in all appropriate spaces may cause your proposal to be disqualified

FAST TRACK PROGRAM QUALIFICATIONS To qualify for the BMDO STTR Fastrack, a company must complete this form and meet the other requirements detailed in the BMDO section of this solicitation (and also on the BMDO web site). Instructions are on the back.

TOPIC #:	CONTRACT #:	PHASE I EFFECTIVE START DATE:	PHASE I COMPLETION DATE:
PHASE I TITLE:			
FIRM:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	
OUTSIDE INVESTOR:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	

BUSINESS CERTIFICATION:

- | | YES | NO | MATCHING RATE |
|--|--------------------------|--------------------------|------------------------------------|
| > Do you have 10 or fewer employees and have never received a Phase II SBIR /STTR award from the federal government (including DoD)?
(if YES, the minimum Investor matching rate is <u>\$1 for every \$4 in BMDO STTR funds</u>) | <input type="checkbox"/> | <input type="checkbox"/> | \$1 : \$4 <input type="checkbox"/> |
| > Have you received 5 or more Phase II SBIR/STTR awards from the federal government (including DoD)?
(If YES, the minimum Investor matching rate is <u>\$1 for every \$1 in BMDO STTR funds</u>) | <input type="checkbox"/> | <input type="checkbox"/> | \$1 : \$1 <input type="checkbox"/> |
| > If you answered NO to both questions, the minimum Investor matching rate is <u>\$1 for every \$2 in BMDO STTR funds.</u> | | | \$1 : \$2 <input type="checkbox"/> |
| > Does the outside funding proposed in this application qualify as a "Fastrack investment", and does the investor qualify as an "outside investor", as defined in DoD Fast Track Guidance (Reference G)? If you have any questions about this, call the DoD SBIR Help Desk (800-382-4634). The Help Desk will refer any policy and/or substantive questions to appropriate DoD personnel for an official response. | <input type="checkbox"/> | <input type="checkbox"/> | |

Caution: knowingly and willfully making any false, fictitious, or fraudulent statements or representations above may be felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to \$10,000, up to five years in prison, or both.

PROPOSED STTR AND MATCHING FUNDS:

- ▶ Proposed STTR Interim Funding: \$ _____
- ▶ Proposed STTR Phase II Funding: \$ _____
- ▶ Investor Matching Interim Funding: \$ _____
- ▶ Investor Matching Phase II Funding: \$ _____

FIRM OFFICIAL		OUTSIDE INVESTOR OFFICIAL	
NAME:		NAME:	
TITLE:		TITLE:	
TELEPHONE:		TELEPHONE:	
SIGNATURE:	DATE:	SIGNATURE:	DATE:

Nothing on this page is classified or proprietary information/data
 Application page No. 1

INSTRUCTIONS FOR COMPLETING FAST TRACK APPLICATION FORM (BMDO)

SUBMISSION:

Submit all items to:

Ballistic Missile Defense Organization
ATTN: TOI/SBIR (Bond)
1725 Jefferson Davis Highway
Suite 809
Arlington, VA 22202

IMPORTANT: Please also send a copy of this application form, when completed, to:

DoD SBIR Program Manager
1777 N. Kent Street, Suite 9100
Arlington, VA 22209

For further information on the BMDO SBIR Program, visit the BMDO SBIR Web Site <http://www.futron.com/bmdo/bmdo.htm>

REQUEST FOR COPIES OF THIS FORM:

Additional copies of this form may be obtained from:

DoD SBIR Support Services
2850 Metro Drive, Suite 600
Minneapolis, MN 55425-1566
(800) 382-4634

BMDO FY00 STTR TOPIC DESCRIPTION

BMDO 00T-001

Electronics and Photonics

INTRODUCTION: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). These increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

DESCRIPTION: The necessary advances in electronics for the many ballistic missile defense applications will require advances in electronics materials. Primary emphasis lies in advancing the capability of integrated circuits, detectors, sensors, large-scale integration, radiation hardness, and all electronic components. Novel quantum-well/superlattice structures that allow the realization of unique elective properties through "band gap engineering" are sought, as are new organic and polymer materials with unique electronic characteristics. In addition, exploitation of the unusual electronic properties of gallium nitride is of considerable interest. Specifically, under high speed switching conditions at >10GHz and/or cryogenic temperatures. Among the many BMDO electronic needs and interest are advances in high frequency transistor structures, solid state lasers, optical detectors, low dielectric constant packaging materials, tailored thermal conductivity, microstructural waveguides, multilayer capacitors, single-electron transistors, metallization methods for repair of conducting paths in polyceramic systems, and sol-gel processing for packaging materials.

Also, dense computing capability is sought in all architectural variations, from all optic to hybrid computers. Specific examples of areas to be addressed include, but are not limited to, high speed multiplexing, monolithic optoelectronic transmitters, holographic methods, reconfigurable interconnects, optoelectronic circuits, and any other technology contributing to advances in intra-computer communications, optical logic gates, bistable memories, optical transistors, and power limiters. Non-linear optical materials advancements and new bistable optical device configurations.

PHASE I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

PHASE II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

SUCCESSFUL PHASE 3/DUAL-USE COMMERCIALIZERS (Real-World Examples): Company Y, with a market cap of \$693M+, commercialized technology that allowed for the delivery of ultra-pure materials to semiconductor thin film reactors and has graduated from small business status. Company Z, with a market cap of \$7M+, manufactures radiation detection devices and was funded for avalanche photodiode arrays under this topic. Company AA, with a market cap of \$216M+, has a substantial market share of the atomic layer epitaxy growth method of semiconductor compound materials based on their efforts developed under this topic. Company BB, with a market cap of \$273M+, which manufactures flat panel display devices, received some initial funding for their silicon-on-insulator films and organometallic chemical vapor deposition technology developments. Company CC, with a market cap of \$178M+, commercialized technology based on degradation resistant laser diodes. Company DD, with a market cap of \$30M+, is commercializing technology based on its surge suppression devices and marketed as SurgX. Company EE, with a market cap of \$1,776M+, had initial funding for its high bandgap

compounds and laser diode products to develop a number of commercial and military products, and has graduated from small business status. Company KK established a multilayer coating technology that can be easily transported to any location for application. Company FF developed a magnetoresistive non-volatile random access memory chip, which is also radiation hardened, and is utilized in a number of space applications for the military and commercial sectors. Company LL, with a market cap of \$26M+, was started with their first Phase I from this topic and the products are used in electronics, structural ceramics, composites, cosmetics and skin care, and as industrial catalysts. Company NN, with a market cap of \$510M+, is leveraging technology developed under this topic for the efficient production of semiconductors from waste recovery during the manufacturing process. Company R took a unique technology approach in addressing fiber-optic and other optical communications applications to both the military and commercial industry. Company S is providing a low-loss electro-optical switching array, Company T is providing optical bus extenders and fiber-optic modulators, Company U has funded technology which utilized wavelength division multiplexing techniques; all three support the ever growing optical communication industry.

DOD KEY TECHNOLOGY AREAS: Air Platforms, Information Systems Technology, Materials/Processes, Sensors, Electronics, Battlespace Environment, Space Platforms, Weapons, Nuclear Technology

9.0 SUBMISSION FORMS AND CERTIFICATIONS

Section 9.0 contains:

- Reference A: Cost Proposal Outline**
A cost proposal following the format in Reference A must be included with each proposal submitted.
- Reference B: Fast Track Application Form**
A DoD program under which projects that attract outside investors receive interim funding and selection for Phase II award provided they are "technically sufficient" and have substantially met Phase I goals.
- Reference C: Model Agreement for the Allocation of Intellectual Property and Follow-on Rights**
This is only a model provided as a guideline for the small business in the development of an agreement that allocates intellectual property rights and rights to follow-on research, development, or commercialization between the small business and the research institution (see Section 3.4.o for more details). The small business is not required to use this model agreement, in whole or part, for its agreement with the research institution. A written agreement between the small business and research institution need not be submitted with the proposal, but must be available upon request.
- Reference D: Proposal Receipt Notification Form**
- Reference E: Directory of Small Business Specialists**
- Reference F: SF 298 Report Documentation Page**
- Reference G: DoD Fast Track Guidance**
- Reference H: List of Eligible FFRDCs**
- Reference I: DoD SBIR/STTR Mailing List Form**

**U.S. DEPARTMENT OF DEFENSE
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
COST PROPOSAL**

Background:

Offerors should indicate the following terms, as appropriate, in their proposal, following the instructions in Section 3.4(m) of this solicitation.

Cost Breakdown Items (in this order, as appropriate):

1. Name of offeror
2. Home office address
3. Location where work will be performed
4. Title of proposed effort
5. Company's taxpayer identification number and CAGE code. *(Note: Offerors that do not yet have these items -- e.g., because the company does not yet exist at the time of proposal submission -- should so indicate in the cost proposal. Such offerors, if selected for award, should talk with their DoD contracting officer about obtaining these items, both of which are required before a contract can be awarded.)*
6. Topic number and topic title from DoD Solicitation Brochure
7. Total dollar amount of the proposal
8. Direct material costs
 - a. Purchased parts (dollars)
 - b. Subcontracted items (dollars)
 - c. Other
 - (1) Raw material (dollars)
 - (2) Your standard commercial items (dollars)
 - (3) Interdivisional transfers (at other than cost dollars)
 - d. Total direct material (dollars)
9. Material overhead (rate _____ %) x total direct material = dollars
10. Direct labor (specify)
 - a. Type of labor, estimated hours, rate per hour and dollar cost for each type (e.g., "computer programmer, 40 hours, \$26 per hour, \$1040 cost"). Include the name as well as hours, etc. of all key personnel.
 - b. Total estimated direct labor (dollars)
11. Labor overhead
 - a. Identify overhead rate, the hour base and dollar cost
 - b. Total estimated labor overhead (dollars)
12. Special testing (include field work at government installations)
 - a. Provide dollar cost for each item of special testing
 - b. Estimated total special testing (dollars)
13. Special equipment
 - a. If direct charge, specify each item and cost of each
 - b. Estimated total special equipment (dollars)
14. Travel (if direct charge)
 - a. Transportation (detailed breakdown and dollars)
 - b. Per diem or subsistence (details and dollars)
 - c. Estimated total travel (dollars)
15. Subcontracts (e.g., consultants)
 - a. Identify each, with purpose, and dollar rates
 - b. Total estimated consultants costs (dollars)
16. Other direct costs (specify)
 - a. Total estimated direct cost and overhead (dollars)
17. General and administrative expense
 - a. Percentage rate applied
 - b. Total estimated cost of G&A expense (dollars)
18. Royalties (specify)
 - a. Estimated cost (dollars)
19. Fee or profit (dollars)
20. Total estimate cost and fee or profit (dollars)
21. The cost breakdown portion of a proposal must be signed by a responsible official, and the person signing must have typed name and title and date of signature must be indicated.
22. On the following items offeror must provide a yes or no answer to each question.
 - a. Has any executive agency of the United States Government performed any review of your accounts or records in connection with any other government prime contract or subcontract within the past twelve months? If yes, provide the name and address of the reviewing office, name of the individual and telephone extension.
 - b. Will you require the use of any government property in the performance of this proposal? If yes, identify.
 - c. Do you require government contract financing to perform this proposed contract? If yes, then specify type as advanced payments or progress payments.
23. Type of contract proposed, either cost-plus-fixed-fee or firm-fixed price.

U.S. DEPARTMENT OF DEFENSE
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
FAST TRACK APPLICATION FORM

Failure to fill in all appropriate spaces may cause your proposal to be disqualified

FAST TRACK PROGRAM QUALIFICATIONS (see Section 4.5 of the solicitation for detailed explanation)

To qualify for the STTR Fast Track, a company must submit a Fast Track application and meet the other requirements detailed in Section 4.5 of the solicitation. This form, when completed and signed by both the company and its investor, should be included as the cover sheet of the Fast Track application. Instructions on where to submit the application are on the back of this form.

TOPIC #:	CONTRACT #:	PHASE I EFFECTIVE START DATE:	PHASE I COMPLETION DATE:
PHASE I TITLE:			
FIRM:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	
OUTSIDE INVESTOR:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	

BUSINESS CERTIFICATION:

- Has your company ever received a Phase II SBIR or STTR award from the federal government (including DoD)?
 If yes, the minimum matching rate is \$1 for every STTR dollar.
 If no, the minimum matching rate is 25 cents for every STTR dollar.
- Does the outside funding proposed in this application qualify as a "Fast Track investment", and does the investor qualify as an "outside investor", as defined in DoD Fast Track Guidance (Reference G)? If you have any questions about this, call the DoD SBIR/STTR Help Desk (800-382-4634). The Help Desk will refer any policy and/or substantive questions to appropriate DoD personnel for an official response.

YES NO

☐ ☐

☐ ☐

Caution: knowingly and willfully making any false, fictitious, or fraudulent statements or representations above may be felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to \$10,000, up to five years in prison, or both.

PROPOSED STTR AND MATCHING FUNDS:

- Proposed DoD STTR funds for the interim effort: \$ _____
- Proposed DoD STTR funds for Phase II: \$ _____
- Total proposed DoD STTR funds (interim + Phase II): \$ _____
- Amount of matching funds (cash) the investor will provide: \$ _____

By signing below, the parties are stating that the outside investor will provide matching funds, in the amount listed above, contingent on the company's selection for Phase II STTR award. If the matching funds are not transferred from the investor to the company within 45 days after DoD has notified the company that it has been selected for Phase II award, the company will be ineligible to compete for a Phase II award not only under the Fast track but also under the regular Phase II competition, unless a specific written exception is granted by the Component STTR program manager.

FIRM OFFICIAL		OUTSIDE INVESTOR OFFICIAL	
NAME:		NAME:	
TITLE:		TITLE:	
TELEPHONE:		TELEPHONE:	
SIGNATURE:	DATE:	SIGNATURE:	DATE:

INSTRUCTIONS FOR COMPLETING REFERENCE B

SUBMISSION:

Submit the Fast Track application, including the three items discussed in Section 4.5(b), to the technical monitor for your Phase I project. In addition, submit a copy of the entire application to the Program Manager of the DoD Component funding the STTR project (addresses below). Finally, send a copy of this application cover sheet, when completed, to the DoD SBIR/STTR Program Manager, OSD/SADBU, 177 N. Kent Street, Suite 9100, Arlington, VA 22209. Do not submit other items in the Fast Track application to the DoD STTR Program Manager.

Department of the Army
Director, Army Research Office
ATTN: AMXRO-RT (Ltc. Ken Jones)
4300 S. Miami Boulevard
Research Triangle Park, NC 27709

Ballistic Missile Defense Organization
ATTN: TOI/STTR (Bond)
1725 Jefferson Davis Highway
Suite 809
Arlington, VA 22202

Department of the Navy
ONR 362 STTR
ATTN: John Williams
800 N. Quincy Street
Arlington, VA 22217-5660

Defense Advanced Research Projects Agency
ATTN: STTR Program Manager (Ms. C. Jacobs)
3701 N. Fairfax Drive
Arlington, VA 22203-1714

Department of the Air Force
AFPL/XPTT, Steve Guilfoos
1864 4th Street, Suite 1, Bldg. 15
Wright Patterson AFB, OH 45433-7131

REQUEST FOR COPIES OF THIS FORM:

Additional forms may be obtained from:

DoD SBIR/STTR Support Services
2850 Metro Drive, Suite 600
Minneapolis, MN 55425-1566
(800) 382-4634

U.S. DEPARTMENT OF DEFENSE
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
FAST TRACK APPLICATION FORM

Failure to fill in all appropriate spaces may cause your proposal to be disqualified

FAST TRACK PROGRAM QUALIFICATIONS (see Section 4.5 of the solicitation for detailed explanation)

To qualify for the STTR Fast Track, a company must submit a Fast Track application and meet the other requirements detailed in Section 4.5 of the solicitation. This form, when completed and signed by both the company and its investor, should be included as the cover sheet of the Fast Track application. Instructions on where to submit the application are on the back of this form.

TOPIC #:	CONTRACT #:	PHASE I EFFECTIVE START DATE:	PHASE I COMPLETION DATE:
PHASE I TITLE:			
FIRM:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	
OUTSIDE INVESTOR:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	

BUSINESS CERTIFICATION:

- | | | |
|--|--------------------------|--------------------------|
| | YES | NO |
| <p>▸ Has your company ever received a Phase II SBIR or STTR award from the federal government (including DoD)?
 If yes, the minimum matching rate is \$1 for every STTR dollar.
 If no, the minimum matching rate is 25 cents for every STTR dollar.</p> | <input type="checkbox"/> | <input type="checkbox"/> |
| <p>▸ Does the outside funding proposed in this application qualify as a "Fast Track investment", and does the investor qualify as an "outside investor", as defined in DoD Fast Track Guidance (Reference G)? If you have any questions about this, call the DoD SBIR/STTR Help Desk (800-382-4634). The Help Desk will refer any policy and/or substantive questions to appropriate DoD personnel for an official response.</p> | <input type="checkbox"/> | <input type="checkbox"/> |

Caution: knowingly and willfully making any false, fictitious, or fraudulent statements or representations above may be felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to \$10,000, up to five years in prison, or both.

PROPOSED STTR AND MATCHING FUNDS:

- | | |
|--|----------|
| ▸ Proposed DoD STTR funds for the interim effort: | \$ _____ |
| ▸ Proposed DoD STTR funds for Phase II: | \$ _____ |
| ▸ Total proposed DoD STTR funds (interim + Phase II): | \$ _____ |
| ▸ Amount of matching funds (cash) the investor will provide: | \$ _____ |

By signing below, the parties are stating that the outside investor will provide matching funds, in the amount listed above, contingent on the company's selection for Phase II STTR award. If the matching funds are not transferred from the investor to the company within 45 days after DoD has notified the company that it has been selected for Phase II award, the company will be ineligible to compete for a Phase II award not only under the Fast track but also under the regular Phase II competition, unless a specific written exception is granted by the Component STTR program manager.

FIRM OFFICIAL		OUTSIDE INVESTOR OFFICIAL	
NAME:		NAME:	
TITLE:		TITLE:	
TELEPHONE:		TELEPHONE:	
SIGNATURE:	DATE:	SIGNATURE:	DATE:

INSTRUCTIONS FOR COMPLETING REFERENCE B

SUBMISSION:

Submit the Fast Track application, including the three items discussed in Section 4.5(b), to the technical monitor for your Phase I project. In addition, submit a copy of the entire application to the Program Manager of the DoD Component funding the STTR project (addresses below). Finally, send a copy of this application cover sheet, when completed, to the DoD SBIR/STTR Program Manager, OSD/SADBU, 177 N. Kent Street, Suite 9100, Arlington, VA 22209. Do not submit other items in the Fast Track application to the DoD STTR Program Manager.

Department of the Army
Director, Army Research Office
ATTN: AMXRO-RT (Lt. Ken Jones)
4300 S. Miami Boulevard
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ATTN: TOI/STTR (Bond)
1725 Jefferson Davis Highway
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Arlington, VA 22202

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ONR 362 STTR
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800 N. Quincy Street
Arlington, VA 22217-5660

Defense Advanced Research Projects Agency
ATTN: STTR Program Manager (Ms. C. Jacobs)
3701 N. Fairfax Drive
Arlington, VA 22203-1714

Department of the Air Force
AFPL/XPTT, Steve Guilfoos
1864 4th Street, Suite 1, Bldg. 15
Wright Patterson AFB, OH 45433-7131

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DoD SBIR/STTR Support Services
2850 Metro Drive, Suite 600
Minneapolis, MN 55425-1566
(800) 382-4634

U.S. DEPARTMENT OF DEFENSE
SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM
FAST TRACK APPLICATION FORM

Failure to fill in all appropriate spaces may cause your proposal to be disqualified

FAST TRACK PROGRAM QUALIFICATIONS (see Section 4.5 of the solicitation for detailed explanation)

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PHASE I TITLE:			
FIRM:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	
OUTSIDE INVESTOR:		TAXPAYER ID#:	
STREET:			
CITY:	STATE:	ZIP:	

BUSINESS CERTIFICATION:

- | | | |
|---|--------------------------|--------------------------|
| | YES | NO |
| ▸ Has your company ever received a Phase II SBIR or STTR award from the federal government (including DoD)?
If yes, the minimum matching rate is \$1 for every STTR dollar.
If no, the minimum matching rate is 25 cents for every STTR dollar. | <input type="checkbox"/> | <input type="checkbox"/> |
| ▸ Does the outside funding proposed in this application qualify as a "Fast Track investment", and does the investor qualify as an "outside investor", as defined in DoD Fast Track Guidance (Reference G)? If you have any questions about this, call the DoD SBIR/STTR Help Desk (800-382-4634). The Help Desk will refer any policy and/or substantive questions to appropriate DoD personnel for an official response. | <input type="checkbox"/> | <input type="checkbox"/> |

Caution: knowingly and willfully making any false, fictitious, or fraudulent statements or representations above may be felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to \$10,000, up to five years in prison, or both.

PROPOSED STTR AND MATCHING FUNDS:

- | | |
|--|----------|
| ▸ Proposed DoD STTR funds for the interim effort: | \$ _____ |
| ▸ Proposed DoD STTR funds for Phase II: | \$ _____ |
| ▸ Total proposed DoD STTR funds (interim + Phase II): | \$ _____ |
| ▸ Amount of matching funds (cash) the investor will provide: | \$ _____ |

By signing below, the parties are stating that the outside investor will provide matching funds, in the amount listed above, contingent on the company's selection for Phase II STTR award. If the matching funds are not transferred from the investor to the company within 45 days after DoD has notified the company that it has been selected for Phase II award, the company will be ineligible to compete for a Phase II award not only under the Fast track but also under the regular Phase II competition, unless a specific written exception is granted by the Component STTR program manager.

FIRM OFFICIAL		OUTSIDE INVESTOR OFFICIAL	
NAME:		NAME:	
TITLE:		TITLE:	
TELEPHONE:		TELEPHONE:	
SIGNATURE:	DATE:	SIGNATURE:	DATE:

INSTRUCTIONS FOR COMPLETING REFERENCE B

SUBMISSION:

Submit the Fast Track application, including the three items discussed in Section 4.5(b), to the technical monitor for your Phase I project. In addition, submit a copy of the entire application to the Program Manager of the DoD Component funding the STTR project (addresses below). Finally, send a copy of this application cover sheet, when completed, to the DoD SBIR/STTR Program Manager, OSD/SADBU, 177 N. Kent Street, Suite 9100, Arlington, VA 22209. Do not submit other items in the Fast Track application to the DoD STTR Program Manager.

Department of the Army
Director, Army Research Office
ATTN: AMXRO-RT (Ltc. Ken Jones)
4300 S. Miami Boulevard
Research Triangle Park, NC 27709

Ballistic Missile Defense Organization
ATTN: TOI/STTR (Bond)
1725 Jefferson Davis Highway
Suite 809
Arlington, VA 22202

Department of the Navy
ONR 362 STTR
ATTN: John Williams
800 N. Quincy Street
Arlington, VA 22217-5660

Defense Advanced Research Projects Agency
ATTN: STTR Program Manager (Ms. C. Jacobs)
3701 N. Fairfax Drive
Arlington, VA 22203-1714

Department of the Air Force
AFPL/XPTT, Steve Guilfoos
1864 4th Street, Suite 1, Bldg. 15
Wright Patterson AFB, OH 45433-7131

REQUEST FOR COPIES OF THIS FORM:

Additional forms may be obtained from:

DoD SBIR/STTR Support Services
2850 Metro Drive, Suite 600
Minneapolis, MN 55425-1566
(800) 382-4634

SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM

ALLOCATION OF RIGHTS IN INTELLECTUAL PROPERTY AND RIGHTS TO CARRY OUT FOLLOW-ON RESEARCH, DEVELOPMENT, OR COMMERCIALIZATION

(This is only a model)

This Agreement between _____, a small business concern organized as a _____ under the laws of _____ and having a principal place of business at _____, ("SBC") and _____, a research institution having a principal place of business at _____, ("RI") is entered into for the purpose of allocating between the parties certain rights relating to an STTR project to be carried out by SBC and RI (hereinafter referred to as the "PARTIES") under an STTR funding agreement that may be awarded by _____ ("AGENCY") to SBC to fund a proposal entitled "_____ submitted, or to be submitted, to AGENCY by SBC on or about _____, 199__.

1. Applicability of this Agreement.

(a) This Agreement shall be applicable only to matters relating to the STTR project referred to in the preamble above.

(b) If a funding agreement for an STTR project is awarded to SBC based upon the STTR proposal referred to in the preamble above, SBC will promptly provide a copy of such funding agreement to RI, and SBC will make a subaward to RI in accordance with the funding agreement, the proposal, and this Agreement. If the terms of such funding agreement appear to be inconsistent with the provisions of this Agreement, the PARTIES will attempt in good faith to resolve any such inconsistencies. However, if such resolution is not achieved within a reasonable period, SBC shall not be obligated to award nor RI to accept the subaward. If a subaward is made by SBC and accepted by RI, this Agreement shall not be applicable to contradict the terms of such subaward or of the funding agreement awarded by AGENCY to SBC except on the grounds of fraud, misrepresentation, or mistake, but shall be considered to resolve ambiguities in the terms of the subaward.

(c) The provisions of this Agreement shall apply to any and all consultants, subcontractors, independent contractors, or other individuals employed by SBC or RI for the purposes of this STTR project.

2. Background Intellectual Property.

(a) "Background Intellectual Property" means property and the legal right therein of either or both parties developed before or independent of this Agreement including inventions, patent applications, patents, copyrights, trademarks, mask works, trade secrets and any information embodying proprietary data such as technical data and computer software.

(b) This Agreement shall not be construed as implying that either party hereto shall have the right to use Background Intellectual Property of the other in connection with this STTR project except as otherwise provided hereunder.

- (1) The following Background Intellectual Property of SBC may be used nonexclusively and, except as noted, without compensation by RI in connection with research or development activities for this STTR project (if "none" so state): _____;
- (2) The following Background Intellectual Property of RI may be used nonexclusively and, except as noted, without compensation by SBC in connection with research or development activities for this STTR project (if "none" so state): _____;
- (3) The following Background Intellectual Property of RI may be used by SBC nonexclusively in connection with commercialization of the results of this STTR project, to the extent that such use is reasonably necessary for practical, efficient and competitive commercialization of such results but not for commercialization independent of the commercialization of such results, subject to any rights of the Government therein and upon the condition that SBC pay to RI, in addition to any other royalty including any royalty specified in the following list, a royalty of ___ % of net sales or leases made by or under the authority of SBC of any product or service that embodies, or the manufacture or normal use of which entails the use of, all or any part of such Background Intellectual Property (if "none" so state): _____.

3. Project Intellectual Property.

(a) "Project Intellectual Property" means the legal rights relating to inventions (including Subject Inventions as defined in 37 CFR § 401), patent applications, patents, copyrights, trademarks, mask works, trade secrets and any other legally protectable information, including computer software, first made or generated during the performance of this STTR Agreement.

(b) Except as otherwise provided herein, ownership of Project Intellectual Property shall vest in the party whose personnel conceived the subject matter or first actually reduced the subject matter to practice, and such party may perfect legal protection therein in its own name and at its own expense. Jointly made or generated Project Intellectual Property shall be jointly owned by the PARTIES unless otherwise agreed in writing. The SBC shall have the first option to perfect the rights in jointly made or generated Project Intellectual Property unless otherwise agreed in writing.

(1) The ownership, including rights to any revenues and profits, resulting from any product, process, or other innovation or invention based on the cooperative shall be allocated between the SBC and the RI as follows:

SBC Percent: _____ RI Percent: _____

(2) Expenses and other liabilities associated with the development and marketing of any product, process, or other innovation or invention shall be allocated as follows:

SBC Percent: _____ RI Percent: _____

(c) The PARTIES agree to disclose to each other, in writing, each and every Subject Invention, which may be patentable or otherwise protectable under the United States patent laws in Title 35, United States Code. The PARTIES acknowledge that they will disclose Subject Inventions to each other and the awarding agency within _____ months after their respective inventor(s) first disclose the invention in writing to the person(s) responsible for patent matters of the disclosing Party. All written disclosures of such inventions shall contain sufficient detail of the invention, identification of any statutory bars, and shall be marked confidential, in accordance with 35 U.S.C. § 205.

(d) Each party hereto may use Project Intellectual Property of the other nonexclusively and without compensation in connection with research or development activities for this STTR project, including inclusion in STTR project reports to the AGENCY and proposals to the AGENCY for continued funding of this STTR project through additional phases.

(e) In addition to the Government's rights under the Patent Rights clause of 37 CFR § 401.14, the PARTIES agree that the Government shall have an irrevocable, royalty free, nonexclusive license for any governmental purpose in any Project Intellectual Property.

(f) SBC will have an option to commercialize the Project Intellectual Property of RI, subject to any rights of the Government therein, as follows--

(1) Where Project Intellectual Property of RI is a potentially patentable invention, SBC will have an exclusive option for a license to such invention, for an initial option period of _____ months after such invention has been reported to SBC. SBC may, at its election and subject to the patent expense reimbursement provisions of this section, extend such option for an additional _____ months by giving written notice of such election to RI prior to the expiration of the initial option period. During the period of such option following notice by SBC of election to extend, RI will pursue and maintain any patent protection for the invention requested in writing by SBC and, except with the written consent of SBC or upon the failure of SBC to reimburse patenting expenses as required under this section, will not voluntarily discontinue the pursuit and maintenance of any United States patent protection for the invention initiated by RI or of any patent protection requested by SBC. For any invention for which SBC gives notice of its election to extend the option, SBC will, within _____ days after invoice, reimburse RI for the expenses incurred by RI prior to expiration or termination of the option period in pursuing and maintaining (i) any United States patent protection initiated by RI and (ii) any patent protection requested by SBC. SBC may terminate such option at will by giving written notice to RI, in which case further accrual of reimbursable patenting expenses hereunder, other than prior commitments not practically revocable, will cease upon RI's receipt of such notice. At any time prior to the expiration or termination of an option, SBC may exercise such option by giving written notice to RI, whereupon the parties will promptly and in good faith enter into negotiations for a license under RI's patent rights in the invention for SBC to make, use and/or sell products and/or services that embody, or the development, manufacture and/or use of which involves employment of, the invention. The terms of such license will include: (i) payment of reasonable royalties to RI on sales of products or services which embody, or the development, manufacture or use of which involves employment of, the invention; (ii) reimbursement by SBC of expenses incurred by RI in seeking and maintaining patent protection for the invention in countries covered by the license (which reimbursement, as well as any such patent expenses incurred directly by SBC with RI's authorization, insofar as deriving

from RI's interest in such invention, may be offset in full against up to _____ of accrued royalties in excess of any minimum royalties due RI); and, in the case of an exclusive license, (iii) reasonable commercialization milestones and/or minimum royalties.

(2) Where Project Intellectual Property of RI is other than a potentially patentable invention, SBC will have an exclusive option for a license, for an option period extending until _____ months following completion of RI's performance of that phase of this STTR project in which such Project Intellectual Property of RI was developed by RI. SBC may exercise such option by giving written notice to RI, whereupon the parties will promptly and in good faith enter into negotiations for a license under RI's interest in the subject matter for SBC to make, use and/or sell products or services which embody, or the development, manufacture and/or use of which involve employment of, such Project Intellectual Property of RI. The terms of such license will include: (i) payment of reasonable royalties to RI on sales of products or services that embody, or the development, manufacture or use of which involves employment of, the Project Intellectual Property of RI and, in the case of an exclusive license, (ii) reasonable commercialization milestones and/or minimum royalties.

(3) Where more than one royalty might otherwise be due in respect of any unit of product or service under a license pursuant to this Agreement, the parties shall in good faith negotiate to ameliorate any effect thereof that would threaten the commercial viability of the affected products or services by providing in such license(s) for a reasonable discount or cap on total royalties due in respect of any such unit.

4. Follow-on Research or Development.

All follow-on work, including any licenses, contracts, subcontracts, sublicenses or arrangements of any type, shall contain appropriate provisions to implement the Project Intellectual Property rights provisions of this agreement and insure that the PARTIES and the Government obtain and retain such rights granted herein in all future resulting research, development, or commercialization work.

5. Confidentiality/Publication.

(a) Background Intellectual Property and Project Intellectual Property of a party, as well as other proprietary or confidential information of a party, disclosed by that party to the other in connection with this STTR project shall be received and held in confidence by the receiving party and, except with the consent of the disclosing party or as permitted under this Agreement, neither used by the receiving party nor disclosed by the receiving party to others, provided that the receiving party has notice that such information is regarded by the disclosing party as proprietary or confidential. However, these confidentiality obligations shall not apply to use or disclosure by the receiving party after such information is or becomes known to the public without breach of this provision or is or becomes known to the receiving party from a source reasonably believed to be independent of the disclosing party or is developed by or for the receiving party independently of its disclosure by the disclosing party.

(b) Subject to the terms of paragraph (a) above, either party may publish its results from this STTR project. However, the publishing party will give a right of refusal to the other party with respect to a proposed publication, as well as a _____ day period in which to review proposed publications and submit comments, which will be given full consideration before publication. Furthermore, upon request of the reviewing party, publication will be deferred for up to _____ additional days for preparation and filing of a patent application which the reviewing party has the right to file or to have filed at its request by the publishing party.

6. Liability.

(a) Each party disclaims all warranties running to the other or through the other to third parties, whether express or implied, including without limitation warranties of merchantability, fitness for a particular purpose, and freedom from infringement, as to any information, result, design, prototype, product or process deriving directly or indirectly and in whole or part from such party in connection with this STTR project.

(b) SBC will indemnify and hold harmless RI with regard to any claims arising in connection with commercialization of the results of this STTR project by or under the authority of SBC. The PARTIES will indemnify and hold harmless the Government with regard to any claims arising in connection with commercialization of the results of this STTR project.

7. Termination.

(a) This agreement may be terminated by either Party upon _____ days written notice to the other Party. This agreement may also be terminated by either Party in the event of the failure of the other Party to comply with the terms of this agreement.

(b) In the event of termination by either Party, each Party shall be responsible for its share of the costs incurred through the effective date of termination, as well as its share of the costs incurred after the effective date of termination, and which are related to the termination. The confidentiality, use, and/or non-disclosure obligations of this agreement shall survive any termination of this agreement.

AGREED TO AND ACCEPTED—

Small Business Concern

By: _____ Date: _____

Print name: _____

Title: _____

Research Institution

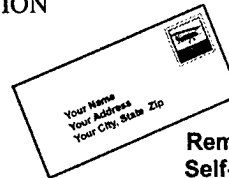
By: _____ Date: _____

Print name: _____

Title: _____

Reference D

RECEIPT NOTIFICATION



**Remember to Stamp Your
Self-Addressed Envelope!**

*Proposer: If you wish to be notified that your
proposal has been received, please submit
this form with a stamped, self-addressed envelope.*

TO:

(Fill in firm name)

(street)

(city, state ZIP)

SUBJECT: STTR Solicitation No. _____

STTR Topic No. _____
(fill in Solicitation and Topic No.)

This is to notify you that your proposal in response to the subject solicitation and topic number has been received by

(Fill in name of organization to which you will send your proposal)

Signature by receiving organization

Date

REF D

DIRECTORY OF SMALL BUSINESS SPECIALISTS

Associate Directors of Small Business assigned at Defense Contract Management Districts (DCMD):
(DCMD EAST -- <http://www.dcmde.dla.mil>; DCMD WEST -- <http://www.dcmdw.dla.mil>)

DCMD WEST

ATTN: Renee Deavens
18901 S. Wilmington, Bldg DH2
Carson, CA 90746
(800) 222-2556
(310) 900-6025
(310) 900-6029 (FAX)
rdeavens@whq.dcmdw.dla.mil

DCMC San Francisco (DCMDW-GFDU)

ATTN: Joan Fosbery
1265 Borregas Avenue
Sunnyvale, CA 94089
(408) 541-7042
(408) 541-7084 (FAX)
jfosbery@dcmdw.dla.mil

DCMC San Diego (DCMDW-GSDU)

ATTN: Enid Allen
7675 Dagget Street, Suite 100
San Diego, CA 92111-2241
(619) 637-4922
(619) 637-4926 (FAX)
eallen@swest.dcmdw.dla.mil

DCMC Seattle (DCMDW-GWDU)

ATTN: Alice Toms
3009 112th Avenue., NE, Suite 200
Bellevue, WA 98004-8019
(425) 889-7317/7318
(425) 889-7252 (FAX)
atoms@seao.dcmdw.dla.mil

DCMC Santa Ana (DCMDW-GADU)

ATTN: Laura Robello
34 Civic Center Plaza, PO Box C-12700
Santa Ana, CA 92172-2700
(714) 836-2700
(714) 836-2045
lrobello@snaao.dcmdw.dla.mil

DCMC Van Nuys (DCMDW-GVDU)

ATTN: Romeo Allas
6230 Van Nuys Blvd.
Van Nuys, CA 91401-2713
(818) 756-4444 (ext. 201)
(818) 904-6532 (FAX)
romeo_allas@vnyao.dcmdw.dla.mil

DCMC St. Louis (DCMDW-GLDU)

ATTN: Ronald T. Nave
1222 Spruce Street
St. Louis, MO 63103-2811
(314) 331-5542
(800) 325-3419
(314) 331-5800 (FAX)
rnave@dcrs.dla.mil

DCMC Phoenix (DCMDW-GPDU)

ATTN: Maria Y. Golightly
Two Renaissance Square
40 N. Central Avenue, Suite 400
Phoenix, AZ 85004
(602) 594-7911
(602) 594-7978 (FAX)
mgolightly@swest.dcmdw.dla.mil

DCMC Chicago (DCMDW-GCDU)

ATTN: Larry Tyma
O'Hare International Airport
PO Box 66911
Chicago, IL 60666-0911
(773) 825-5366
(773) 825-5914 (FAX)
ltyma@dcmdw.dla.mil

DCMC Denver (DCMDW-GDDU)

ATTN: Robert Sever
Orchard Place, Suite 200
5975 Greenwood Plaza Blvd.
Englewood, CO 80110-4715
(303) 843-4300 (ext. 180/181)
(800) 722-8975 (ext. 165)
(303) 843-4334 (FAX)
rsever@englew.dcmdc.dla.mil

DCMC Twin Cities (DCMDW-GTDU)

ATTN: Otto Murry
3001 Metro Drive, Suite 200
Bloomington, MN 55425-1573
(612) 814-4103
(612) 814-4256/4154 (FAX)
omurry@gt-link.dcmdc.dla.mil

DCMC Wichita (DCMDW-GKDU)

ATTN: Richard Storie
271 W. 23rd Street N. Suite 6000
Wichita, KS 67202-2095
(316) 299-7218
(316) 299-7304 (FAX)
rstorie@wichit.dcmdc.dla.mil

DCMC Dallas (DCMDW-GBDU)
ATTN: Willis Jones
1200 Main Street, Room 520
Dallas, TX 75202-4399
(214) 670-9205
(214) 573-2182 (FAX)
wjones@dcmdw.dla.mil

DCMC San Antonio (DCMDW-GEDU)
ATTN: Jimmy Heston
615 E. Houston Street, PO Box 1040
San Antonio, TX 78294
(210) 472-4650 (ext. 213)
(210) 472-4667 (FAX)
jheston@texas.dcrd.dla.mil

DCMD EAST (DCMDE-DU)
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495 Summer Street, 8th Floor
Boston, MA 02210-2184
(617) 753-4318
(617) 7533174 (FAX)
bdu1150@dcmd.e.dla.mil

DCMC Clearwater (DCMDE-GCDU)
ATTN: Sandra Scanlan
Gadsen Building, 9549 Koger Blvd., Suite 200
St. Petersburg, FL 33702-2455
(727) 579-3093
(727) 579-3106 (FAX)
sscanlan@dcmd.e.dla.mil

DCMC Atlanta (DCMDE-GADU)
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805 Walker Street, Suite 1
Marietta, GA 30060-2789
(770) 590-6197
(770) 590-6551 (FAX)
jmasone@dcmd.e.dla.mil

DCMC Cleveland (DCMDE-GZDU)
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555 E 88th Street
Bratenah, OH 44108-1068
(216) 681-1571
(216) 681-1719 (FAX)
cszlembarski@dcmd.e.dla.mil

DCMC Lockheed Martin Marietta (DCMDE-RHD)
ATTN: Erma A. Peacock
86 South Cobb Drive, Building B-2
Marietta, GA 30063-0260
(770) 494-2016
(770) 494-7883 (FAX)
epeacock@dcmd.e.dla.mil

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ATTN: Thomas E. Watkins
1725 Van Patton Drive, Building 30, Area C
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(937) 656-3104
(937) 656-3228 (FAX)
twatkins@dcmd.e.dla.mil

DCMC Baltimore (DCMDE-GTDU)
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217 East Redwood St.
Baltimore, MD 21202
(410) 962-9735
(410) 962-3349 (FAX)
gprouty@dcmd.e.dla.mil

DCMC Detroit (DCMDE-GJDU)
ATTN: David C. Boyd
Building 231
Warren, MI 48397-5000
(810) 574-4474
(810) 574-6078 (FAX)
dboyd@dcmd.e.dla.mil

DCMC Birmingham (DCMDE-GLDU)
ATTN: Jim W. Brown
Burger Phillips Center
1910 3rd Avenue, N., Suite 201
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(205) 716-7875 (FAX)
jibrown@dcmd.e.dla.mil

DCMC Hartford (DCMDE-GUDU)
ATTN: Carl Cromer
130 Darlin Street
East Hartford, CT 06108
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(860) 291-7779 (FAX)
ccromer@dcmd.e.dla.mil

DCMC Boston (DCMDE-GFDU)
ATTN: Philip R. Varney
495 Summer Street
Boston, MA 02210-2138
(617) 753-3467/4110
(617) 753-4005 (FAX)
pvarney@dcmd.e.dla.mil

DCMC Long Island (DCMDE-GGDU)
ATTN: Eileen Kelly
605 Stewart Ave
Garden City
Long Island, NY 11530-4761
(516) 228-5722
(516) 228-5938 (FAX)
bvc2251@dcrb.dla.mil

DCMC Indianapolis (DCMDE-GIDU)
ATTN: D. Middleton
8899 E 56th Street
Indianapolis, IN 46249-5701
(317) 510-2015
(317) 510-2348 (FAX)
dmiddleton@dcmde.dla.mil

DCMC New York (DCMC-GNDU)
ATTN: John Castellane
Ft. Wadsworth, 207 New York Avenue
Staten Island, NY 10305-5013
(718) 390-1016
(718) 390-1020 (FAX)
bvn3724@dcmde.dla.mil

DCMC Orlando (DCMDE-GODU)
ATTN: Barbara Gaines
3555 Maguire Blvd
Orlando, FL 32803-3726
(407) 228-5149
(407) 228-5221 (FAX)
bgaines@dcmde.dla.mil

DCMC Pittsburgh (DCMDE-GPDU)
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1612 Federal Building
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(412) 395-5977
(412) 395-5907 (FAX)
dchapman@dcmde.dla.mil

DCMC Springfield (DCMDE-GXDU)
ATTN: Otis Boggs
Building 1, ARDEC
Picatinny, NJ 07806-5000
(973) 724-8204
(973) 724-2496 (FAX)
bgx0659@dcmde.dla.mil

DCMC Philadelphia (DCMDE-GDDU)
ATTN: Yvette Wright
P.O. Box 11427
Philadelphia, PA 19111-0427
(215) 737-5818
(215) 737-5873 (FAX)
ywright@dcmde.dla.mil

DCMC Syracuse (DCMDE-GSDU)
ATTN: Ralph Vinciguerra
615 Erie Blvd, West
Syracuse, NY 13204
(315) 448-7897
(315) 448-7914 (FAX)
bsu6449@dcmde.dla.mil

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED		
4. TITLE AND SUBTITLE			5. FUNDING NUMBERS	
6. AUTHOR(S)				
7. PERFORMING ORGANIZATION NAME (S) AND ADDRESS(ES)			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)				
14. SUBJECT TERMS			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to stay within the lines to meet optical scanning requirements.

Block 1. Agency Use Only (Leave blank).

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1Jan88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10Jan87 - 30Jun88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, and volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C - Contract	PR - Project
G - Grant	TA - Task
P - Program Element	WU - Work Unit
	Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s)

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. Self-explanatory

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. Of...; To be published in... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement.

Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD	- See DoDD5230.24, "Distribution Statements on Technical Documents"
DOE	- See authorities.
NASA	- See handbook NHB 2200.2.
NTIS	- Leave blank.

Block 12b. Distribution Code.

DOD	- Leave blank.
DOE	- Enter DOE distribution categories from the Standard Distribution for Reports.
NASA	- Leave blank.
NTIS	- Leave blank.

Block 13. Abstract. Include a brief (Maximum 200 words) factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code (NTIS) only.

Block 17-19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

Standard Form

DoD Fast Track Guidance

This paper contains DoD's official guidance on what types of relationships between a small company and outside investors in the company qualify as an investment under the SBIR and STTR Fast Track ("Fast Track investment"). It includes specific examples of company-investor relationships that we have been asked about and our official responses on whether these relationships qualify as a Fast Track investment. If you have questions about whether a particular company-investor relationship qualifies, please contact the DoD SBIR/STTR Help Desk (tel. 800/382-4634, fax 800/462-4128, e-mail SBIRHELP@teltech.com). The Help Desk will refer any policy or substantive questions to appropriate DoD personnel for an official response.

I. General Guidance on What Qualifies As A "Fast Track Investment"

The investor must be an **outside** investor, which may include such entities as another company, a venture capital firm, an individual "angel" investor, a non-SBIR/non-STTR government program, or any combination of the above. It does not include the owners of the small business, their family members, and/or "affiliates" of the small business, as defined in Title 13 of the *Code of Federal Regulations* (C.F.R.), Section 121.103. As discussed in that Section:

Concerns are affiliates of each other when one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

[We] consider factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists.

Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, may be treated as one party with such interests aggregated.

Although DoD is guided by this definition of affiliation in the Code of Federal Regulations, we also exercise our own discretion whether a particular entity qualifies as an "outside investor".

The **investment** must be an arrangement in which the outside party provides cash to the small company in return for such items as: equity; a share of royalties; rights in the technology; a percentage of profit; an advance purchase order for products resulting from the technology; or any combination of the above.

II. Specific examples of What Does and Does Not Qualify As a "Fast Track Investment"

A. Examples of What Qualifies as an "Outside" Investor

(1) Can a small company contribute its own internal funds to qualify for the Fast Track?

No. DoD is seeking outside validation of the commercial potential of the company's technology, and therefore requires that the funds come from an outside investor. Also, cash from an outside investor shows up plainly on the company's books and therefore can be more readily verified than a company's own matching contribution.

(2) Company A spins off company B, which wins a phase I SBIR award. Company A then wants to contribute matching funds to qualify company B for the Fast Track. Can A be considered an outside investor for purposes of the Fast Track?

In making our determination of whether company A is an outside investor, we would be guided by the definition of "affiliates" in 13 C.F.R. Sec. 121.103, discussed above. Our presumption is that in this example A and B would be considered "affiliates," and that A would therefore not be an outside investor for purposes of the Fast Track. However, that presumption could be rebutted by showing, for example, that the spin-off occurred several years ago and that A and B do not exercise control over one another, do not have common ownership or management, have different business interests, etc.

(3) Small company S wins a phase I SBIR award. The president of S is a major shareholder in another company Y, which wants to contribute matching funds to qualify S for the Fast Track. Can Y be considered an outside investor?

Our presumption is that Y would not be considered an outside investor. Our determination would be guided by whether the president's stake in Y is large enough that S and Y would be considered "affiliates" under 13 C.F.R. Sec. 121.103. Subsection c of Section 121.103 specifically discusses affiliation based on stock ownership:

c. Affiliation based on stock ownership.

1. A person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock.
2. If two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

If S and Y are found to be affiliates, we would determine that Y is not an outside investor.

(4) Does the outside investor have to be a single entity (e.g., a single venture capital firm) or can it be more than one entity (e.g., two angel investors and a venture capital firm)?

It can be more than one entity.

(5) Small company A contributes matching funds to small company B in order to qualify B for the Fast Track, and, at the same time, B contributes matching funds to A in order to qualify A for the Fast Track. Do A and B qualify as outside investors under the Fast Track?

No. A and B's relationship is such that their investment in each other would not provide outside validation of the commercial potential of their respective SBIR projects. We would therefore not consider them to be outside investors for purposes of the Fast Track.

(6) Can the brother of an employee of small company S contribute funds to qualify S for the Fast Track?

Probably not. Again, we would be guided by the definition of "affiliates" in 13 C.F.R. Sec. 121.103. The brother presumptively would be an affiliate of company S and not an outside investor.

(7) Venture capital firm V currently is a 22 percent shareholder in small company S. Can V invest additional funds in S to qualify S for the Fast Track?

Our presumption is yes. In making our determination, we would be guided by whether V and S are "affiliates," as defined in 13 C.F.R. Sec. 121.103. Section 121.103 provides (in subsection (b)(5)) that a venture capital firm is not affiliated with a company if the venture capital firm does not control the company -- e.g., by owning more than 50 percent of the stock of a small company (prior to its investment under the Fast Track), as described in 13 C.F.R. 107.865. 13 C.F.R. 107.865 can be viewed on the internet at <http://www.acq.osd.mil/sadbu/sbir/affil2.htm>.

(8) Large company L makes a cash investment in small company S, and then serves as a subcontractor to S on an SBIR project. Can L's investment in S count as a matching contribution for purposes of the Fast Track?

Only L's cash investment net of its subcontracting effort can count as matching funds for purposes of the Fast Track. For example, if L invests \$750,000 in S and subcontracts with S for \$250,000, only L's net contribution (\$500,000) can count as matching funds for purposes of the Fast Track.

(9) Company Y makes a cash investment in small company S for purposes of the Fast Track, and also enters into a separate contract with S under which Y provides certain goods/services to S in return for \$500,000. Can Y's cash investment in S count as a matching contribution for purposes of the Fast Track?

As in the previous example, only Y's cash investment net of the \$500,000 it receives from S can count as matching funds for purposes of the Fast Track. However, if the separate contract between Y and S pre-dates S's submission of its phase I SBIR proposal, Y's entire cash investment can count as matching funds for purposes of the Fast Track.

(10) A group of investors wishes to invest funds in small company S to qualify S for the Fast Track. One of the investors is the mother of S's president, who wants to contribute \$50,000 toward the effort. Can the group's investment in S count as a matching contribution to qualify S for the Fast Track?

The mother's investment of \$50,000 does not count, because she is not an outside investor (see item (6) above). Contributions of the other investors can count provided that they meet the other conditions for the Fast Track (e.g., each must be an outside investor).

B. Examples of What Qualifies as an "Investment"

(1) Can a loan from an outside party qualify as an "investment" for purposes of the Fast Track?

No. The rationale behind the Fast Track is that an outside party is betting on the company's success in bringing the technology to market -- not just its ability to repay a loan.

(2) How about a loan that is convertible to equity?

A loan that is convertible to equity at the company's discretion would count as an investment under the following circumstances: (1) the loan is provided by a public entity (e.g., a state agency), or (2) the loan is provided by a private entity, and the SBIR company actually converts the loan to equity before the end of phase I.

(3) Can in-kind contributions from an outside investor count as matching funds under the Fast Track?

No. The matching contribution must be in cash. A cash contribution is a stronger signal of the outside investor's interest in the technology, and can be readily verified.

(4) Can a purchase order from an outside investor count as a matching contribution under the Fast Track?

An advance purchase order for new products resulting from the SBIR project can count as a matching contribution under the Fast Track (assuming the other Fast Track conditions are met).

(5) Can the funds raised from an initial public offering (IPO) count as matching funds for purposes of the Fast Track?

Yes, as long as the offering memo indicates that a portion of the funds from the IPO will pay for work (e.g., R&D, marketing, etc.) that is related to the SBIR project.

(6) If large company L pays small company S for work related to S's SBIR project and expects a deliverable (goods or services) from S in return, would that qualify as an "investment"?

No, for the same reason a loan does not count. Specifically, in this situation the large company is not betting on the small company's success in bringing the technology to market, but merely on its ability to provide the deliverable.

C. Examples Re: Timing/Logistics of the Fast Track Investment

(1) Can entity E's investment in small company S during the first month of S's phase I SBIR project count as a matching contribution to qualify S for the Fast Track?

Yes, provided that E is an outside investor and that the other Fast Track conditions are met. The investment can occur any time after the start of the phase I project.

(2) Small company A, which has won a phase I award, spins off small company B to commercialize the SBIR technology. A then convinces angel investor I to invest funds in B. Can I's investment in B count as a matching contribution to qualify A for the Fast Track?

For I's investment in B to qualify A for the Fast Track, DoD must determine that A and B are substantially the same entity, as evidenced, for example, by their meeting the definition of "affiliates" in 13 C.F.R. Sec.121.103. If DoD determines that A and B are substantially the same entity, I's investment in B could qualify A for the Fast Track. Of course, the parties must also meet the other conditions for the Fast Track (e.g., I must be an outside investor).

(3) Small company S is collaborating with a university on an STTR project. Investor I wishes to provide funds to the university in order to qualify S for the STTR Fast Track. Can I's investment in the university count as a matching contribution to qualify S for the Fast Track?

In order to qualify S for the STTR Fast Track, I's investment of funds must be in small company S, not in the university. S can then subcontract some of the funds to the university. The rationale is that a cash investment in the small company is a very strong indication of commercial potential, whereas an investment in the university is less so.

List of Eligible Federally Funded Research and Development Centers (FFRDCs)

Federal Agency	Administered by	FFRDC
DoD/OSD	Carnegie Mellon University	Software Engineering Institute (SEI) Carnegie Mellon University Pittsburgh, PA 15213-3890 Steve Cross (412) 268-7740
DoD/AF	Massachusetts Institute of Technology	Lincoln Laboratory 244 Wood Street Lexington, MA 02420-9108 Ms. Joyce Yaffee (781) 981-7056
DoE	Bechtel BWXT Idaho, L.L.C. University of Chicago; Argonne National Lab; Westinghouse Electric Corp.	Idaho National Engineering and Environmental Laboratory 2525 N. Fremont Ave. PO Box 1625, Mailstop 3805 Idaho Falls, ID 83415 Mr. Charles Briggs (208) 526-0441
DoE	Lockheed Martin Energy Research Corp.	Oak Ridge National Laboratory PO Box 2008 Oak Ridge, TN 37831-6255 Dr. Alvin W. Trivelpiece (423) 576-2900
DoE	Sandia Corp. (A subsidiary of Lockheed Martin Co.)	Sandia National Laboratory ATTN: 7 Technologies, Inc. Albuquerque, NM 87185 Mr. Jesus Martinex (505) 843-4143
DoE	Westinghouse Electric Corp.	Savannah River Technology Center Westinghouse Electric Corp. Aiken, SC 29808 Ms. Angela Sistrunk (803) 725-8123
DoE	Iowa State University of Science and Technology	Ames Laboratory Iowa State University Ames, IA 50011 Dr. Thomas J. Barton (515) 294-2770

DoE	Brookhaven Science Associates, Inc.	Brookhaven National Laboratory Bldg. 460 Upton, NY 11973 Dr. Marburger (516) 344-2772 Ms. Margaret Bogosian (516) 344-7338
DoE	University of Chicago	Argonne National Laboratory 9700 South Cass Ave. Argonne, IL 60439 Dr. Yoon Chang (630) 252-2481
DoE	Southeastern Universities Research Association, Inc.	Thomas Jefferson National Accelerator Facility 12000 Jefferson Ave. Newport News, VA 23606 Dr. Hermann Grunder (757) 269-7426
DoE	University of California	Lawrence Berkeley National Laboratory University of California Berkeley, CA 94720 Dr. Charles V. Shank (510) 486-5111
DoE	University of California	Lawrence Livermore Laboratory University of California P.O. Box 808 Livermore, CA 94550 Mr. Bruce Tarter (925) 422-4169
DoE	Universities Research Association, Inc.	Fermi National Accelerator Laboratory P.O. Box 500 Batavia, IL 60510 Dr. Michael Witherell (630) 840-3211
DoE	University of California	Los Alamos National Laboratory PO Box 1663, MS A100 Los Alamos, NM 87545 Mr. John C. Browne (505) 667-5101
DoE	Princeton University	Princeton Plasma Physics Laboratory PO Box 451 Princeton, NJ 08543 Mr. Robert Goldston (609) 243-3553

DoE	Stanford University	Stanford Linear Accelerator Center PO Box 4349 Stanford, CA 94309 Prof. Jonathan Dorfman (650) 926-2601
DoE	Lovelace Biomedical and Environmental Research Institute	Lovelace Respiratory Research Institute PO Box 5890 Albuquerque, NM 87185 Dr. Bob Rubin (505) 845-1041
DoE	Battelle Memorial Institute	Pacific Northwest National Laboratories PO Box 999, Mail Stop K1-46 Richland, WA 99352 Dr. J.T. Adrian Roberts (509) 375-6600
DoE	Midwest Research Institute	National Renewable Energy Research Laboratory 1617 Cole Blvd. Golden, CO 80401 Mr. Richard Truly (303) 275-3011
HHS/NIH	Program Resources, Inc.; BioScience Laboratories, Inc.; Harlan Sprague Dawley, Inc.; Data Management Services, Inc.	Frederick Cancer Research and Development Center P.O. Box B Frederick, MD 21702 Dr. Summers (301) 846-5096
NASA	California Institute of Technology	Jet Propulsion Laboratory 4800 Oak Grove Drive Mail Stop 180-904 Pasadena, CA 91109 Dr. Edward Stone (818) 354-4321
NSF	RAND Corp.	Science and Technology Policy Institute 1333 H Street NW; Suite 800 Washington, DC 20005 Dr. Bruce Don (202) 296-5000 x5276
NSF	Cornell University	National Astronomy and Ionosphere Center Cornell University Space Sciences Bldg. Ithaca, NY 14853-6801 Mr. Paul Goldsmith (607) 255-0606

NSF	University Corporation for Atmospheric Research	National Center for Atmospheric Research P.O. Box 3000 Boulder, CO 90307 Mr. Robert Serafin
NSF	Association of Universities for Research in Astronomy, Inc.	National Optical Astronomy Observatories 950 North Cherry Avenue P.O. Box 26732 Tucson, AZ 85726-6732 Dr. Sidney C. Wolff
NSF	Associated Universities, Inc.	National Radio Astronomy Observatory 520 Edgemont Road Charlottesville, VA 22903-2475 Dr. Paul Vanden Bout (804) 296-0241
NRC	Southwest Research Institute	Center for Nuclear Waste Regulatory Analyses PO Drawer 28510 San Antonio, TX 78228-0510 Dr. Wes Patrick (210) 522-5158
DoT	MITRE Corp.	Center for Advanced Aviation System Development The MITRE Corporation 1820 Dolly Madison Blvd. McLean, VA 22102-3481 Mr. Amr A. ElSawy (703) 883-7824
IRS	IIT Research Institute	IIT Research Institute 8100 Corporate Drive, Suite 400 Lanham, MD 20785-2231 Dr. Barry Watson (301) 731-8894

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